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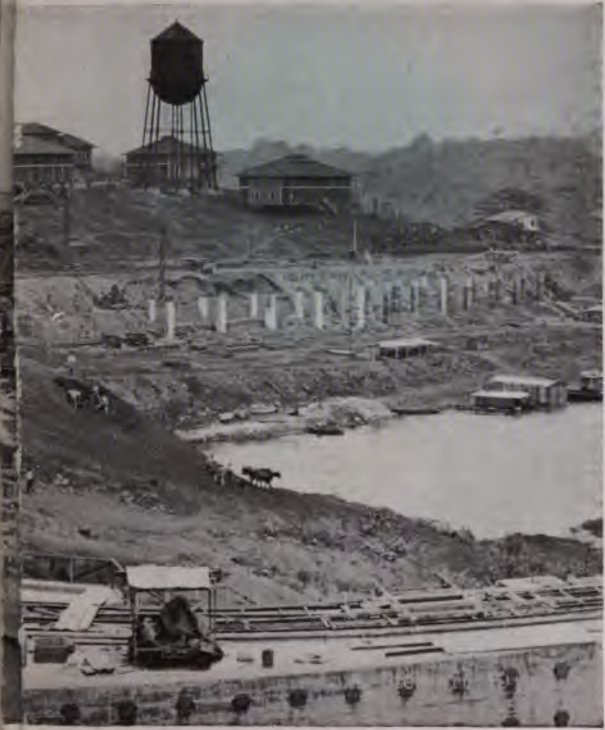

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GENERAL CONDITIONS OF SALE

C. I. F. AND C. & F. SALES

The seller referred to in these Conditions of Sale is the UNITED STATES STEEL PRODUCTS COMPANY.

Delivery

1. (*a*) Tender to the purchaser or his authorized agent of shipping documents, consisting of proper bills of lading, and, in the case of c. i. f. sales, a negotiable insurance certificate, shall constitute full and final delivery on the part of the seller, and shall entitle it to immediate payment in full for the goods covered by said shipping documents, without prejudice to the subsequent adjustment of just claims on the part of the purchaser.

1. (*b*) The seller shall not be responsible for the arrival of the goods at destination nor for loss or damage in transit from the manufacturer's works, and in case of such loss or damage shall be under no obligation to replace goods so lost or damaged. The purchaser accepts and agrees to all usual and customary clauses in the bills of lading as well as such additional clauses and stipulations as may be lawfully imposed by the carriers as a condition of their accepting the goods for transportation.

1. (*c*) Unless otherwise agreed in writing, the purchaser undertakes to receive the goods at destination ex ship's tackles as fast as the vessel can discharge, failing which, any demurrage or other charges shall be for the purchaser's account. It is further agreed that the seller is entitled to select the route, port of shipment and vessel with privilege of stopping in transit at a port or ports. Unless otherwise agreed in writing, any charges at destination, including lighterage, wharfage or landing charges, dues, duties, etc., are not included in the seller's prices.

Insurance

2. Unless otherwise agreed in writing in connection with the particular c. i. f. transaction, the insurance to be covered by the seller is understood to be marine insurance only, free of particular average, English conditions, for a sum equal to the amount of the invoice plus ten per cent. Other forms of insurance, if obtainable, must be agreed upon in writing prior to the making of the contract, the additional cost to be for

GENERAL CONDITIONS OF SALE (C. I. F. AND C. & F. SALES).—*Continued*

account of the purchaser, but no form of insurance will protect against rust or other damage unless caused by a peril of the sea.

Consular Invoices

3. (*a*) All consular fees for legalizing invoices, stamping bills of lading or other documents required by the laws of the countries of destination, are payable by the purchaser and are not included in the seller's prices. Unless otherwise arranged, the seller is authorized to pay all such charges for the purchaser's account, and to add the cost of same to the amount of the invoice.

3. (*b*) Unless otherwise arranged, the seller will take out consular documents as agent for the purchaser, who must state how the goods are to be declared, and, if the purchaser does not furnish the necessary instructions, the seller will make declaration according to its best judgment, but will not in any case be responsible for any fines or other charges due to errors or incorrect declarations.

Excusable Delays

4. The seller shall not be liable for any delay in manufacture or delivery due to fires, strikes, disputes with workmen, war, civil commotion, epidemics, floods, accidents, delays in transportation, shortage of cars, shortage of fuel or other material, shortage of labor, acts, demands or requirements of the Government of the United States, or of any other State or Government, or to any other causes beyond the reasonable control of the seller, or of the manufacturer, and the existence of such causes of delay shall justify the suspension of manufacture and shall extend the time of performance on the part of the seller to such extent as may be necessary to enable it to make delivery in the exercise of reasonable diligence after the causes of delay have been removed. If the performance of the contract by the seller be delayed by reason of any of the causes above mentioned, the purchaser may, subject to previously obtaining the consent of the seller, cancel the purchase of such portion of the goods for which details and shipping instructions have been duly furnished in accordance with the contract, as may have been subjected to such delay, provided such portion of the goods has not been manufactured nor is in

GENERAL CONDITIONS OF SALE (C. I. F. AND C. & F. SALES).—*Continued*

process of manufacture at the time the purchaser's request for such cancellation arrives at the manufacturer's works. The provisions of this paragraph shall not be limited nor waived by any other terms of the contract, whether printed or written.

Partial Shipments

5. The seller may ship any portion of the goods as soon as completed at the manufacturer's works, and payment for any portion of the goods as shipped shall become due in accordance with the terms of payment. Insistence by the purchaser on suspension of manufacture or of any shipment, if not acquiesced in by the seller, may be treated by the seller as a wrongful termination of the contract on the part of the purchaser; and the purchaser shall thereupon be liable for all damages arising out of such termination.

Details and Shipping Instructions (Specifications)

6. If the purchaser fails to furnish details and shipping instructions to enable the seller to perform this contract in accordance with its terms, the seller shall be entitled at its option, and in addition to all other rights, to cancel such portion of the contract as may remain unexecuted, or to make shipment in accordance with the details and shipping instructions which the purchaser may have furnished for previous shipments on account of the same or a previous contract. The purchaser shall not, however, be entitled to change or modify, except with the consent of the seller, any specification, details or instructions comprised in the contract itself.

Inspection

7. Inspection of the goods, if agreed to, must be made at the manufacturer's works, and such inspection and acceptance shall be final. Reasonable facilities will be afforded to inspectors, representing the purchaser, to make such inspection and to apply, previous to shipment from the manufacturer's works, tests in accordance with the specifications to which the seller has previously agreed.

Claims

8. The seller shall not be liable for any claims unless they are made promptly after receipt of the goods and due opportunity has been given for investigation by the seller's own representatives. The seller shall not be liable for any claims for labor nor for consequential damages. Goods must not be returned except by permission of the seller.

GENERAL CONDITIONS OF SALE (C. I. F. AND C. & F. SALES).—*Continued*

Damage in Transit

9. The seller agrees that the goods shall leave the manufacturer's works in good condition, and the purchaser assumes all risks of rust and other damage and loss during transportation.

General

10. (*a*) The goods are to be exported to the destination stated by the purchaser at the time the inquiry is made, and the purchaser guarantees that the goods will be shipped to that destination, and agrees to furnish, if required by the seller, a Landing Certificate duly signed by the Customs Authorities at the port of destination, certifying that the goods have been landed and entered at that port.

10. (*b*) The seller reserves the right, even after partial payment on account of any contract with the purchaser, to require from the purchaser satisfactory security for the due performance of any and all of his obligations, and refusal to furnish such satisfactory security or the failure of the purchaser to perform any of his obligations under this or any other existing contract will entitle the seller, upon notice to the purchaser, to suspend shipments or to cancel the contract, or so much of it as may remain unexecuted, without prejudice to any claim for damages the seller may be entitled to make.

10. (*c*) All drawbacks of duties paid on materials entering into the manufacture of the goods shall accrue to the seller, and the purchaser agrees to furnish the seller with all documents necessary to obtain payment of such drawbacks and to co-operate with the seller in obtaining such payment.

Terms of Payment

11. Unless otherwise agreed in writing, the terms of payment are net cash in exchange for the documents hereinabove mentioned, to be tendered to bankers approved by the seller, with whom credit, in favor of the seller, for the full amount of the contract or sale, is to be established concurrently with the making of the contract, this credit to be confirmed to the seller by the bankers and to remain in full force and effect until the order or contract shall have been completely performed. Delay by the purchaser in establishing such credit, or in establishing such other credit as may be agreed upon in writing, shall extend the time for the performance of

the contract by the seller to such extent as may be necessary to enable it to make delivery in the exercise of reasonable diligence after such credit has been established, or, at the seller's option, may be treated by the seller as a wrongful termination of the contract on the part of the purchaser and the purchaser shall thereupon be liable for all damages arising out of such termination.

12. Every quotation is based on the understanding that, if accepted and the seller so elect, a formal contract, satisfactory to the seller, will be signed by the purchaser.

SALES F.A.S. VESSEL

The seller referred to in these Conditions of Sale is the UNITED STATES STEEL PRODUCTS COMPANY.

Delivery

1. (*a*) It is understood and agreed that f. a. s. vessel means delivery by the carrier alongside the vessel or at the wharf, pier, or other customary place of receiving goods destined for shipment by the vessel. The seller may, at its option, tender to the purchaser or his agent the usual ship's receipt or a prepaid inland bill of lading from the works to the port of shipment, providing for free delivery by the carrier within the usual lighterage or railroad delivery limits of the port. Tender of such ship's receipt or inland bill of lading shall constitute full and final delivery. In every case, the purchaser agrees to furnish the seller, promptly after the sailing of the vessel, a Custom House bill of lading properly signed, checked and endorsed, as evidence of exportation.

1. (*b*) In case the seller elects to tender to the purchaser the usual ship's receipt, the purchaser agrees to furnish the seller, on demand, the name of the vessel by which shipment is desired, and such other shipping instructions as may be necessary: and the seller undertakes to place the goods alongside the vessel, if sufficient time be allowed for delivery by the carrier and the vessel in question will receive the goods, but the seller shall not be liable for expenses arising from failure of the carrier to make delivery within the specified time.

GENERAL CONDITIONS OF SALE (F. A. S. VESSEL).—*Continued*

1. (*c*) In case the purchaser does not furnish the seller, on demand, the name of the vessel and such other shipping instructions as may be necessary, or, in case the purchaser designates a vessel of which the date of sailing is such that the goods become subject to charges, (1) any demurrage or other charges made by the carrier for detention of cars, unloading, storage, etc., and any damage to the goods consequent upon such detention or unloading will be for the purchaser's account and risk, and (2) the seller may, at its option, tender to the purchaser or his agent an order on the carrier to deliver the goods to the purchaser at the place of delivery designated by the carrier, and the tender of such delivery order shall constitute full and final delivery.

1. (*d*) Delivery as hereinabove provided, namely, by tender to the purchaser or his agent of such ship's receipt, inland bill of lading or delivery order shall entitle the seller to immediate payment in full for the goods covered by such documents, without prejudice to the subsequent adjustment of just claims on the part of the purchaser.

1. (*e*) The seller shall not be responsible for the arrival of the goods f. a. s. vessel nor for loss or damage in transit from the manufacturer's works, and in case of such loss or damage shall be under no obligation to replace goods so lost or damaged.

Excusable Delays

2. The seller shall not be liable for any delay in manufacture or delivery due to fires, strikes, disputes with workmen, war, civil commotion, epidemics, floods, accidents, delays in transportation, shortage of cars, shortage of fuel or other material, shortage of labor, acts, demands or requirements of the Government of the United States or of any other State or Government, or to any other causes beyond the reasonable control of the seller or of the manufacturer, and the existence of such causes of delay shall justify the suspension of manufacture and shall extend the time of performance on the part of the seller to such extent as may be necessary to enable it to make delivery in the exercise of reasonable diligence after the causes of delay have been removed. If the performance of the contract by the seller be delayed by reason of any of the

GENERAL CONDITIONS OF SALE (F. A. S. VESSEL).—*Continued*

causes above mentioned, the purchaser may, subject to previously obtaining the consent of the seller, cancel the purchase of such portion of the goods for which details and shipping instructions have been duly furnished in accordance with the contract, as may have been subjected to such delay, provided such portion of the goods has not been manufactured nor is in process of manufacture at the time the purchaser's request for such cancellation arrives at the manufacturer's works. The provisions of this paragraph shall not be limited nor waived by any other terms of the contract, whether printed or written.

Partial Shipments

3. The seller may ship any portion of the goods as soon as completed at the manufacturer's works, and payment for any portion of the goods as shipped shall become due in accordance with the terms of payment. Insistence by the purchaser on suspension of manufacture or of any shipment, if not acquiesced in by the seller, may be treated by the seller as a wrongful termination of the contract on the part of the purchaser; and the purchaser shall thereupon be liable for all damages arising out of such termination.

Details and Shipping Instructions (Specifications)

4. If the purchaser fails to furnish details and shipping instructions to enable the seller to perform this contract in accordance with its terms, the seller shall be entitled at its option, and in addition to all other rights, to cancel such portion of the contract as may remain unexecuted, or to make shipment in accordance with the details and shipping instructions which the purchaser may have furnished for previous shipments on account of the same or a previous contract. The purchaser shall not, however, be entitled to change or modify, except with the consent of the seller, any specification, details or instructions comprised in the contract itself.

Inspection

5. Inspection of the goods, if agreed to, must be made at the manufacturer's works, and such inspection and acceptance shall be final. Reasonable facilities will be afforded to inspectors, representing the purchaser, to make such inspection and to apply, previous to shipment from the manufacturer's works, tests in accordance with the specifications to which the seller has previously agreed.

Claims

6. The seller shall not be liable for any claims unless they are made promptly after receipt of the goods and due oppor-

GENERAL CONDITIONS OF SALE (F. A. S. VESSEL).—*Continued*

tunity has been given for investigation by the seller's own representatives. The seller shall not be liable for any claims for labor nor for consequential damages. Goods must not be returned except by permission of the seller.

Damage in Transit

7. The seller agrees that the goods shall leave the manufacturer's works in good condition, and the purchaser assumes all risks of rust and other damage and loss during transportation.

General

8. (*a*) The goods are to be exported to the destination stated by the purchaser at the time the inquiry is made, and the purchaser guarantees that the goods will be shipped to that destination, and agrees to furnish, if required by the seller, a Landing Certificate duly signed by the Customs Authorities at the port of destination, certifying that the goods have been landed and entered at that port.

8. (*b*) The seller reserves the right, even after partial payment on account of any contract with the purchaser, to require from the purchaser satisfactory security for the due performance of any and all of his obligations, and refusal to furnish such satisfactory security or the failure of the purchaser to perform any of his obligations under this or any other existing contract will entitle the seller, upon notice to the purchaser, to suspend shipments or to cancel the contract, or so much of it as may remain unexecuted, without prejudice to any claim for damages the seller may be entitled to make.

8. (*c*) All drawbacks of duties paid on materials entering into the manufacture of the goods shall accrue to the seller, and the purchaser agrees to furnish the seller with all documents necessary to obtain payment of such drawbacks and to cooperate with the seller in obtaining such payment.

Terms of Payment

9. Unless otherwise agreed in writing, the terms of payment are net cash in exchange for the documents hereinabove mentioned, to be tendered to bankers approved by the seller, with whom credit, in favor of the seller, for the full amount of the contract or sale, is to be established concurrently with the making of the contract, this credit to be confirmed to the seller by the bankers and to remain in full force and effect until the order or contract shall have been completely performed.

GENERAL CONDITIONS OF SALE (F. A. S. VESSEL).—*Continued*

Delay by the purchaser in establishing such credit, or in establishing such other credit as may be agreed upon in writing, shall extend the time for the performance of the contract by the seller to such extent as may be necessary to enable it to make delivery in the exercise of reasonable diligence after such credit has been established, or, at the seller's option, may be treated by the seller as a wrongful termination of the contract on the part of the purchaser and the purchaser shall thereupon be liable for all damages arising out of such termination.

10. Every quotation is based on the understanding that, if accepted and the seller so elect, a formal contract, satisfactory to the seller, will be signed by the purchaser.

SALES F.O.B. MILL

The seller referred to in these Conditions of Sale is the UNITED STATES STEEL PRODUCTS COMPANY.

1. It is understood and agreed that f. o. b. mill means delivery free on board cars at the manufacturer's works, and any allowance or prepayment by the seller of freight charges, whether included in the sales price or paid for the purchaser's account, shall not extend the obligations of the seller with respect to delivery, nor shall the seller be under any obligation to replace goods lost or damaged in transit. Unless otherwise agreed in writing, any prepayment of freight charges by the seller shall be for account of the purchaser, and shall be added to the amount of the invoice and repaid by the purchaser on presentation thereof. **Delivery**

2. If the sales price be inclusive of freight from the manufacturer's works to an agreed destination, the seller shall be entitled to select the carrier and routing. If the freight charges are not included in the sales price, the purchaser shall be entitled to select any routing officially authorized and published by the transportation companies, provided he advises the seller of such routing at the time of placing the order. The seller, however, reserves the right to change to any available route if inability to secure cars promptly, or other reasons, would involve delay in forwarding goods over the route selected by the purchaser. **Routing**

GENERAL CONDITIONS OF SALE (F. O. B. MILL).—*Continued*

Freight Rates

3. If the sales price be inclusive of freight to an ag
destination, it is understood and agreed that such pric
based upon the lowest official freight rate in effect at the
of the sale, and any difference between such rate and the
actually paid when the goods are forwarded from the m
facturer's works, whether such difference results from ch
in rate or change in route, shall be for the purchaser's acco
that is to say, any increase shall be added to the price and
decrease shall be deducted therefrom.

Insurance

4. It is understood and agreed that in no case does
sales price, even although inclusive of freight, cover the co
any insurance, but if the route selected as above provide
volves movement of the goods by water, or by rail and w
for which the freight rate does not include insurance, the
chaser will repay to the seller the cost of such marine i
ance as the seller may effect.

Excusable Delays

5. The seller shall not be liable for any delay in man
ture or delivery due to fires, strikes, disputes with work
war, civil commotion, epidemics, floods, accidents, dela
transportation, shortage of cars, shortage of fuel or o
material, shortage of labor, acts, demands or requirement
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make delivery in the exercise of reasonable diligence afte
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instructions have been duly furnished in accordance with
contract, as may have been subjected to such delay, prov
such portion of the goods has not been manufactured nor
process of manufacture at the time the purchaser's reques
such cancellation arrives at the manufacturer's works.

GENERAL CONDITIONS OF SALE (F. O. B. MILL).—*Continued*

provisions of this paragraph shall not be limited nor waived by any other terms of the contract, whether printed or written.

Partial Shipments

6. The seller may ship any portion of the goods as soon as completed at the manufacturer's works, and payment for any portion of the goods as shipped shall become due in accordance with the terms of payment. Insistence by the purchaser on suspension of manufacture or of any shipment, if not acquiesced in by the seller, may be treated by the seller as a wrongful termination of the contract on the part of the purchaser; and the purchaser shall thereupon be liable for all damages arising out of such termination.

Details and Shipping Instructions (Specifications)

7. If the purchaser fails to furnish details and shipping instructions to enable the seller to perform this contract in accordance with its terms, the seller shall be entitled, at its option, and in addition to all other rights, to cancel such portion of the contract as may remain unexecuted, or to make shipment in accordance with the details and shipping instructions which the purchaser may have furnished for previous shipments on account of the same or a previous contract. The purchaser shall not, however, be entitled to change or modify except with the consent of the seller, any specification, details or instructions comprised in the contract itself.

Inspection

8. Inspection of the goods, if agreed to, must be made at the manufacturer's works, and such inspection and acceptance shall be final. Reasonable facilities will be afforded to inspectors, representing the purchaser, to make such inspection and to apply, previous to shipment from the manufacturer's works, tests in accordance with the specifications to which the seller has previously agreed.

Claims

9. The seller shall not be liable for any claims unless they are made promptly after receipt of the goods and due opportunity has been given for investigation by the seller's own representatives. The seller shall not be liable for any claims for labor nor for consequential damages. Goods must not be returned except by permission of the seller.

Damage in Transit

10. The seller agrees that the goods shall be in good condition when delivered on cars at the manufacturer's works.

GENERAL CONDITIONS OF SALE (F. O. B. MILL).—*Continued*

General

11. (*a*) The goods are to be exported to the destination stated by the purchaser at the time the inquiry is made, and the purchaser guarantees that the goods will be shipped to that destination, and agrees to furnish, if required by the seller, a Landing Certificate duly signed by the Customs Authorities at the port of destination, certifying that the goods have been landed and entered at that port.

11. (*b*) The seller reserves the right, even after partial payment on account of any contract with the purchaser, to require from the purchaser satisfactory security for the due performance of any and all of his obligations, and refusal to furnish such satisfactory security or the failure of the purchaser to perform any of his obligations under this or any other existing contract will entitle the seller, upon notice to the purchaser, to suspend shipments or to cancel the contract, or so much of it as may remain unexecuted, without prejudice to any claim for damages the seller may be entitled to make.

11. (*c*) All drawbacks of duties paid on materials entering into the manufacture of the goods shall accrue to the seller, and the purchaser agrees to furnish the seller with all documents necessary to obtain payment of such drawbacks and to co-operate with the seller in obtaining such payment.

Terms

12. Unless otherwise agreed in writing the terms of payment are net cash on presentation of invoice and inland bill of lading to bankers approved by the seller, with whom credit, in favor of the seller for the full amount of the contract or sale, is to be established concurrently with the making of the contract, this credit to be confirmed to the seller by the bankers and to remain in full force and effect until the order or contract shall have been completely performed. Delay by the purchaser in establishing such credit, or in establishing such other credit as may be agreed upon in writing, shall extend the time for the performance of the contract by the seller to such extent as may be necessary to enable it to make delivery in the exercise of reasonable diligence after such credit has been established, or, at the seller's option, may be treated by the seller as a wrongful termination of the contract on the part of the purchaser and the purchaser shall thereupon be liable for all damages arising out of such termination.

13. This quotation is based on the understanding that, if accepted and the seller so elects, a formal contract, satisfactory to the seller, will be signed by the purchaser.

WEIGHTS AND MEASURES ENGLISH AND METRIC EQUIVALENTS

1 pound (lb.) =453.6 grammes.
100 lbs. =45.36 kilos.
112 lbs. =50.80 kilos.
1 net ton (2000 lbs.) =907.2 kilos.
1 gross ton (2240 lbs.) =1016 kilos.
1 kilo =2.2046 lbs.
100 kilos =220.46 lbs.
1 metric ton (1000 kilos) =2204.6 lbs. =0.9842 gross ton =1.1023 net tons.
1 inch =25.40 millimeters.
1 foot (12 inches) =30.48 centimeters.
1 yard (3 feet) =91.44 centimeters.
1 mile (1760 yards) =1609.35 meters.
1 millimeter =0.03937 inch.
1 centimeter =0.3937 inch.
1 meter =39.37 inches =3.2808 feet.
1 kilometer =0.62137 mile =1093.6 yards.
1 square inch =6.4516 square centimeters. =645.16 square millimeters.
1 square foot =0.0929 square meter.
1 square yard =0.8361 square meter.
1 square millimeter =0.00155 square inch.
1 square centimeter =0.155 square inch.
1 square meter =10.7639 square feet. =1.196 square yards.
1 pound per foot =1.4882 kilos per meter.
1 pound per yard =0.4961 kilo per meter.
1 pound per square inch =0.0703 kilo per square centimeter.
1 pound per square foot =4.8825 kilos per square meter.
1 kilo per meter =0.6720 pound per foot.
1 kilo per square millimeter =1422.32 pounds per square inch.
1 kilo per square centimeter =14.2232 pounds per square inch.
1 kilo per square meter =0.2048 pound per square foot. =1.8433 pounds per square yard.

METRIC CONVERSION TABLES

Showing the equivalents according to the Metric System, of Dimensions and Weights according to the English System of Weights and Measures, and for converting Metric Dimensions and Weights into their equivalents according to the English System.

INCHES TO MILLIMETERS

($\frac{1}{64}$ inch to 7$\frac{63}{64}$ inches, advancing by sixty-fourths)

Inches		1	2	3	4	5	6	7
	m/m	m/m	m/m	m/m	m/m	m/m	m/m	m/m
		25.40	50.80	76.20	101.60	127.00	152.40	177.80
1/64	.397	25.80	51.20	76.60	102.00	127.40	152.80	178.20
1/32	.794	26.20	51.60	77.00	102.40	127.80	153.20	178.60
3/64	1.191	26.59	51.99	77.39	102.79	128.19	153.59	178.99
1/16	1.588	26.99	52.39	77.79	103.19	128.59	153.99	179.39
5/64	1.984	27.38	52.78	78.18	103.58	128.98	154.38	179.78
3/32	2.381	27.78	53.18	78.58	103.98	129.38	154.78	180.18
7/64	2.778	28.18	53.58	78.98	104.38	129.78	155.18	180.58
1/8	3.175	28.58	53.98	79.38	104.78	130.18	155.58	180.98
9/64	3.572	28.97	54.37	79.77	105.17	130.57	155.97	181.37
5/32	3.969	29.37	54.77	80.17	105.57	130.97	156.37	181.77
11/64	4.366	29.77	55.17	80.57	105.97	131.37	156.77	182.17
3/16	4.763	30.16	55.56	80.96	106.36	131.76	157.16	182.56
13/64	5.159	30.56	55.96	81.36	106.76	132.16	157.56	182.96
7/32	5.556	30.95	56.35	81.75	107.15	132.55	157.95	183.35
15/64	5.953	31.35	56.75	82.15	107.55	132.95	158.35	183.75
1/4	6.350	31.75	57.15	82.55	107.95	133.35	158.75	184.15
17/64	6.747	32.15	57.55	82.95	108.35	133.75	159.15	184.55
9/32	7.144	32.54	57.94	83.34	108.74	134.14	159.54	184.94
19/64	7.541	32.94	58.34	83.74	109.14	134.54	159.94	185.34
5/16	7.938	33.34	58.74	84.14	109.54	134.94	160.34	185.74
21/64	8.334	33.73	59.13	84.53	109.93	135.33	160.73	186.13
11/32	8.731	34.13	59.53	84.93	110.33	135.73	161.13	186.53
23/64	9.128	34.53	59.93	85.33	110.73	136.13	161.53	186.93
3/8	9.525	34.93	60.33	85.73	111.13	136.53	161.93	187.33
25/64	9.922	35.32	60.72	86.12	111.52	136.92	162.32	187.72
13/32	10.32	35.72	61.12	86.52	111.92	137.32	162.72	188.12
27/64	10.72	36.12	61.52	86.92	112.32	137.72	163.12	188.52
7/16	11.11	36.51	61.91	87.31	112.71	138.11	163.51	188.91

METRIC CONVERSION TABLES.—*Continued*

INCHES TO MILLIMETERS.—*Continued*

Inches		1	2	3	4	5	6	7
	m/m	m/m	m/m	m/m	m/m	m/m	m/m	m/m
29/64	11.51	36.91	62.31	87.71	113.11	138.51	163.91	189.31
15/32	11.91	37.31	62.71	88.11	113.51	138.91	164.31	189.71
31/64	12.30	37.70	63.10	88.50	113.90	139.30	164.70	190.10
1/2	12.70	38.10	63.50	88.90	114.30	139.70	165.10	190.50
33/64	13.10	38.50	63.90	89.30	114.70	140.10	165.50	190.90
17/32	13.49	38.89	64.29	89.69	115.09	140.49	165.89	191.29
35/64	13.89	39.29	64.69	90.09	115.49	140.89	166.29	191.69
9/16	14.29	39.69	65.09	90.49	115.89	141.29	166.69	192.09
37/64	14.68	40.08	65.48	90.88	116.28	141.68	167.08	192.48
19/32	15.08	40.48	65.88	91.28	116.68	142.08	167.48	192.88
39/64	15.48	40.88	66.28	91.68	117.08	142.48	167.88	193.28
5/8	15.88	41.28	66.68	92.08	117.48	142.88	168.28	193.68
41/64	16.27	41.67	67.07	92.47	117.87	143.27	168.67	194.07
21/32	16.67	42.07	67.47	92.87	118.27	143.67	169.07	194.47
43/64	17.07	42.47	67.87	93.27	118.67	144.07	169.47	194.87
11/16	17.46	42.86	68.26	93.66	119.06	144.46	169.86	195.26
45/64	17.86	43.26	68.66	94.06	119.46	144.86	170.26	195.66
23/32	18.26	43.66	69.06	94.46	119.86	145.26	170.66	196.06
47/64	18.65	44.05	69.45	94.85	120.25	145.65	171.05	196.45
3/4	19.05	44.45	69.85	95.25	120.65	146.05	171.45	196.85
49/64	19.45	44.85	70.25	95.65	121.05	146.45	171.85	197.25
25/32	19.84	45.24	70.64	96.04	121.44	146.84	172.24	197.64
51/64	20.24	45.64	71.04	96.44	121.84	147.24	172.64	198.04
13/16	20.64	46.04	71.44	96.84	122.24	147.64	173.04	198.44
53/64	21.03	46.43	71.83	97.23	122.63	148.03	173.43	198.83
27/32	21.43	46.83	72.23	97.63	123.03	148.43	173.83	199.23
55/64	21.83	47.23	72.63	98.03	123.43	148.83	174.23	199.63
7/8	22.23	47.63	73.03	98.43	123.83	149.23	174.63	200.03
57/64	22.62	48.02	73.42	98.82	124.22	149.62	175.02	200.42
29/32	23.02	48.42	73.82	99.22	124.62	150.02	175.42	200.82
59/64	23.42	48.82	74.22	99.62	125.02	150.42	175.82	201.22
15/16	23.81	49.21	74.61	100.01	125.41	150.81	176.21	201.61
61/64	24.21	49.61	75.01	100.41	125.81	151.21	176.61	202.01
31/32	24.61	50.01	75.41	100.81	126.21	151.61	177.01	202.41
63/64	25.00	50.40	75.80	101.20	126.60	152.00	177.40	202.80

METRIC CONVERSION TABLES.—*Continued*

MILLIMETERS TO INCHES

m/m		10	20	30	40	50	60	70	80	90
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
0		0.394	0.787	1.181	1.575	1.969	2.362	2.756	3.150	3.543
1	.03937	0.433	0.827	1.220	1.614	2.008	2.402	2.795	3.189	3.583
2	.07874	0.472	0.866	1.260	1.654	2.047	2.441	2.835	3.228	3.622
3	.11811	0.512	0.906	1.299	1.693	2.087	2.480	2.874	3.268	3.661
4	.15748	0.551	0.945	1.339	1.732	2.126	2.520	2.913	3.307	3.701
5	.19685	0.591	0.984	1.378	1.772	2.165	2.559	2.953	3.346	3.740
6	.23622	0.630	1.024	1.417	1.811	2.205	2.598	2.992	3.386	3.780
7	.27559	0.669	1.063	1.457	1.850	2.244	2.638	3.032	3.425	3.819
8	.31496	0.709	1.102	1.496	1.890	2.283	2.677	3.071	3.465	3.858
9	.35433	0.748	1.142	1.535	1.929	2.322	2.717	3.110	3.504	3.898

INCHES TO CENTIMETERS

(8 to 39⅞ inches, advancing by eights)

Inches		⅛"	¼"	⅜"	½"	⅝"	¾"	⅞"
	c m	c m	c m	c m	c m	c/m	c/m	c/m
8	20.32	20.64	20.95	21.27	21.59	21.91	22.22	22.54
9	22.86	23.18	23.49	23.81	24.13	24.45	24.76	25.08
10	25.40	25.72	26.03	26.35	26.67	26.99	27.30	27.62
11	27.94	28.26	28.57	28.89	29.21	29.53	29.84	30.16
12	30.48	30.80	31.11	31.43	31.75	32.07	32.38	32.70
13	33.02	33.34	33.65	33.97	34.29	34.61	34.92	35.24
14	35.56	35.88	36.19	36.51	36.83	37.15	37.46	37.78
15	38.10	38.42	38.73	39.05	39.37	39.69	40.00	40.32
16	40.64	40.96	41.27	41.59	41.91	42.23	42.54	42.86
17	43.18	43.50	43.81	44.13	44.45	44.77	45.08	45.40
18	45.72	46.04	46.35	46.67	46.99	47.31	47.62	47.94
19	48.26	48.58	48.90	49.21	49.53	49.85	50.16	50.48
20	50.80	51.12	51.43	51.75	52.07	52.39	52.70	53.02
21	53.34	53.66	53.97	54.29	54.61	54.93	55.24	55.56
22	55.88	56.20	56.51	56.83	57.15	57.47	57.78	58.10
23	58.42	58.74	59.05	59.37	59.69	60.01	60.32	60.64

METRIC CONVERSION TABLES.—*Continued*

INCHES TO CENTIMETERS.—*Continued*

Inches		⅛"	¼"	⅜"	½"	⅝"	¾"	⅞"
	c/m	c/m	c/m	c/m	c/m	c/m	c/m	c/m
24	60.96	61.28	61.59	61.91	62.23	62.55	62.86	63.18
25	63.50	63.82	64.13	64.45	64.77	65.09	65.40	65.72
26	66.04	66.36	66.67	66.99	67.31	67.63	67.94	68.26
27	68.58	68.90	69.21	69.53	69.85	70.17	70.48	70.80
28	71.12	71.44	71.75	72.07	72.39	72.71	73.02	73.34
29	73.66	73.98	74.29	74.61	74.93	75.25	75.56	75.88
30	76.20	76.52	76.83	77.15	77.47	77.79	78.10	78.42
31	78.74	79.06	79.37	79.69	80.01	80.33	80.64	80.96
32	81.28	81.60	81.91	82.23	82.55	82.87	83.18	83.50
33	83.82	84.14	84.45	84.77	85.09	85.41	85.72	86.04
34	86.36	86.68	86.99	87.31	87.63	87.95	88.26	88.58
35	88.90	89.22	89.53	89.85	90.17	90.49	90.80	91.12
36	91.44	91.76	92.07	92.39	92.71	93.03	93.34	93.66
37	93.98	94.30	94.61	94.93	95.25	95.57	95.88	96.20
38	96.52	96.84	97.15	97.47	97.79	98.11	98.42	98.74
39	99.06	99.38	99.69	100.01	100.33	100.65	100.96	101.28

CENTIMETERS TO INCHES

c/m		10	20	30	40	50	60	70	80	90
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
0		3.937	7.874	11.811	15.748	19.685	23.622	27.559	31.496	35.433
1	0.3937	4.331	8.268	12.205	16.142	20.079	24.016	27.953	31.890	35.827
2	0.7874	4.724	8.661	12.598	16.535	20.472	24.409	28.346	32.283	36.220
3	1.1811	5.118	9.055	12.992	16.929	20.866	24.803	28.740	32.677	36.614
4	1.5748	5.512	9.449	13.386	17.323	21.260	25.197	29.134	33.071	37.008
5	1.9685	5.906	9.843	13.780	17.717	21.654	25.591	29.528	33.465	37.402
6	2.3622	6.299	10.236	14.173	18.110	22.047	25.984	29.921	33.858	37.795
7	2.7559	6.693	10.630	14.567	18.504	22.441	26.378	30.315	34.252	38.189
8	3.1496	7.087	11.024	14.961	18.898	22.835	26.772	30.709	34.646	38.583
9	3.5433	7.480	11.417	15.354	19.291	23.228	27.165	31.102	35.039	38.976

METRIC CONVERSION TABLES.—*Continued*

INCHES TO METERS

(40 to 99 inches, advancing by inches)

Inches	40	50	60	70	80
	Meters	Meters	Meters	Meters	Meters
	1.016	1.270	1.524	1.778	2.032
1	1.041	1.295	1.549	1.803	2.057
2	1.067	1.321	1.575	1.829	2.083
3	1.092	1.346	1.600	1.854	2.108
4	1.118	1.372	1.626	1.880	2.134
5	1.143	1.397	1.651	1.905	2.159
6	1.168	1.422	1.676	1.930	2.184
7	1.194	1.448	1.702	1.956	2.210
8	1.219	1.473	1.727	1.981	2.235
9	1.245	1.499	1.753	2.007	2.261

INCHES TO METERS

(100 to 1200 inches, advancing by hundreds)

Inches	Meters	Inches	Meters	Inches	M
100	2.540	500	12.700	900	
200	5.080	600	15.240	1000	
300	7.620	700	17.780	1100	
400	10.160	800	20.320	1200	

METERS TO FEET

Meters		10	20	30	40	50	60	70	80
	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet
0		32.81	65.62	98.43	131.23	164.04	196.85	229.66	262.
1	3.2808	36.09	68.90	101.71	134.51	167.32	200.13	232.94	265.
2	6.5617	39.37	72.18	104.99	137.79	170.60	203.41	236.22	269.
3	9.8425	42.65	75.46	108.27	141.07	173.88	206.69	239.50	272.
4	13.1233	45.93	78.74	111.55	144.35	177.16	209.97	242.78	275.
5	16.4042	49.21	82.02	114.83	147.63	180.44	213.25	246.06	278.
6	19.6850	52.50	85.31	118.12	150.92	183.73	216.54	249.35	282.
7	22.9658	55.78	88.59	121.40	154.20	187.01	219.82	252.63	285.
8	26.2467	59.06	91.87	124.68	157.48	190.29	223.10	255.91	288.
9	29.5275	62.34	95.15	127.96	160.76	193.57	226.38	259.19	292.

METRIC CONVERSION TABLES.—*Continued*

FEET AND INCHES TO METERS

(0′ 1″ to 44′ 11″, advancing by one inch.)

Feet	INCHES											
	0″	1″	2″	3″	4″	5″	6″	7″	8″	9″	10″	11″
	Meters	Meters	Meters	Meters	Meters	Meters	Meters	Meters	Meters	Meters	Meters	Meters
0	0.	0.025	0.051	0.076	0.102	0.127	0.152	0.178	0.203	0.229	0.254	0.279
1	0.305	0.330	0.356	0.381	0.406	0.432	0.457	0.483	0.508	0.533	0.559	0.584
2	0.610	0.635	0.660	0.686	0.711	0.737	0.762	0.787	0.813	0.838	0.864	0.889
3	0.914	0.940	0.965	0.991	1.016	1.041	1.067	1.092	1.118	1.143	1.168	1.194
4	1.219	1.245	1.270	1.295	1.321	1.346	1.372	1.397	1.422	1.448	1.473	1.499
5	1.524	1.549	1.575	1.600	1.626	1.651	1.676	1.702	1.727	1.753	1.778	1.803
6	1.829	1.854	1.880	1.905	1.930	1.956	1.981	2.007	2.032	2.057	2.083	2.108
7	2.134	2.159	2.184	2.210	2.235	2.261	2.286	2.311	2.337	2.362	2.388	2.413
8	2.438	2.464	2.489	2.515	2.540	2.565	2.591	2.616	2.642	2.667	2.692	2.718
9	2.743	2.769	2.794	2.819	2.845	2.870	2.896	2.921	2.946	2.972	2.997	3.023
10	3.048	3.073	3.099	3.124	3.150	3.175	3.200	3.226	3.251	3.277	3.302	3.227
11	3.353	3.378	3.404	3.429	3.454	3.480	3.505	3.531	3.556	3.581	3.607	3.632
12	3.658	3.683	3.708	3.734	3 759	3.785	3.810	3.835	3.861	3.886	3.912	3.937
13	3.962	3.988	4.013	4 039	4.064	4.089	4.115	4.140	4.166	4.191	4.216	4.242
14	4.267	4.293	4.318	4.343	4.369	4.394	4.420	4.445	4.470	4.496	4.521	4.547
15	4.572	4.597	4.623	4.648	4.674	4.699	4.724	4.750	4.775	4.801	4.826	4.851
16	4.877	4.902	4.928	4.953	4.978	5.004	5.029	5.055	5.080	5.105	5.131	5.156
17	5.182	5.207	5.232	5.258	5.283	5.309	5.334	5.359	5.385	5.410	5.436	5.461
18	5.486	5.512	5.537	5.563	5.588	5.613	5.639	5.664	5.690	5.715	5.740	5.766
19	5.791	5.817	5.842	5.867	5.893	5.918	5.944	5.969	5.994	6.020	6.045	6.071
20	6.096	6.121	6.147	6.172	6.198	6.223	6.248	6.274	6.299	6.325	6.350	6.375
21	6.401	6.426	6.452	6.477	6.502	6.528	6.553	6.579	6.604	6.629	6.655	6.680
22	6.706	6.731	6.756	6.782	6.807	6.833	6.858	6.883	6.909	6.934	6.960	6.985
23	7.010	7.036	7.061	7.087	7.112	7.137	7.163	7.188	7.214	7 239	7.264	7.290
24	7.315	7.341	7.366	7.391	7.417	7.442	7.468	7.493	7.518	7.544	7.569	7.595
25	7.620	7.645	7.671	7.696	7.722	7.747	7.772	7.798	7.823	7.849	7.874	7.899
26	7.925	7.950	7.976	8.001	8.026	8.052	8.077	8.103	8.128	8.153	8.179	8.204
27	8.230	8.255	8.280	8.306	8.331	8.357	8.382	8.407	8.433	8.458	8.484	8.509
28	8.534	8.560	8.585	8.611	8.636	8.661	8.687	8.712	8.738	8.763	8.788	8.814
29	8.839	8.865	8.890	8.915	8.941	8.966	8.992	9.017	9.042	9.068	9.093	9.119
30	9.144	9.169	9.195	9.220	9.246	9.271	9.296	9.322	9.347	9.373	9.398	9.423
31	9.449	9.474	9.500	9.525	9.550	9.576	9.601	9.627	9.652	9.677	9.703	9.728
32	9.754	9.779	9 804	9.830	9.855	9.881	9.906	9.931	9.957	9.982	10.008	10.033
33	10.058	10.084	10.109	10.135	10.160	10.185	10.211	10.236	10.262	10.287	10.312	10.338
34	10.363	10.389	10.414	10.439	10.465	10.490	10.516	10.541	10.566	10.592	10.617	10.643
35	10.668	10.693	10.719	10.744	10.770	10.795	10.820	10.846	10.871	10.897	10.922	10.947
36	10.973	10.998	11.024	11.049	11.074	11.100	11.125	11.151	11.176	11.201	11.227	11.252
37	11.278	11.303	11.328	11.354	11.379	11.405	11.430	11.455	11.481	11.506	11.532	11.557
38	11.582	11.608	11.633	11.659	11.684	11.709	11.735	11.760	11.786	11.811	11.836	11.862
39	11.887	11.913	11.938	11.963	11.989	12.014	12.040	12.065	12.090	12.116	12.141	12.167
40	12.192	12.217	12.243	12.268	12.294	12.319	12.344	12.370	12.395	12.421	12.446	12.471
41	12.497	12.522	12.548	12.573	12.598	12.624	12.649	12.675	12.700	12.725	12.751	12.776
42	12.802	12.827	12.852	12.878	12.903	12.929	12.954	12.979	13.005	13.030	13.056	13.081
43	13.106	13.132	13.157	13.183	13.208	13.233	13.259	13.284	13.310	13.335	13.360	13.386
44	13.411	13.437	13.462	13.487	13.513	13.538	13.564	13.589	16.614	13.640	13.665	13.691

METRIC CONVERSION TABLES.—*Continued*

FEET TO METERS.—*Continued*

(40 to 99 feet, advancing by one foot)

Feet	40	50	60	70	80	90
	Meters	Meters	Meters	Meters	Meters	Meters
0	12.192	15.240	18.288	21.336	24.384	27.432
1	12.497	15.545	18.593	21.641	24.689	27.737
2	12.802	15.850	18.898	21.946	24.994	28.042
3	13.107	16.155	19.203	22.251	25.299	28.347
4	13.411	16.459	19.507	22.555	25.603	28.651
5	13.716	16.764	19.812	22.860	25.908	28.956
6	14.021	17.069	20.117	23.165	26.213	29.261
7	14.326	17.374	20.422	23.470	26.518	29.566
8	14.630	17.678	20.726	23.774	26.822	29.870
9	14.935	17.983	21.031	24.079	27.127	30.175

FEET TO METERS.—*Continued*

(100 to 9900 feet, advancing by 100 feet)

Feet		1000	2000	3000	4000
	Meters	Meters	Meters	Meters	Meters
		304.80	609.60	914.40	1219.10
100	30.48	335.28	640.08	944.88	1249.68
200	60.96	365.76	670.56	975.36	1280.16
300	91.44	396.24	701.04	1005.84	1310.64
400	121.92	426.72	731.52	1036.32	1341.12
500	152.40	457.20	762.00	1066.80	1371.60
600	182.88	487.68	792.48	1097.28	1402.08
700	213.36	518.16	822.96	1127.76	1432.56
800	243.84	548.64	853.44	1158.24	1463.04
900	274.32	579.12	883.92	1188.72	1493.52
	5000	6000	7000	8000	9000
	Meters	Meters	Meters	Meters	Meters
	1524.00	1828.80	2133.60	2438.40	2743.20
100	1554.48	1859.28	2164.08	2468.88	2773.68
200	1584.96	1889.76	2194.56	2499.36	2804.16
300	1615.44	1920.24	2225.04	2529.84	2834.64
400	1645.92	1950.72	2255.52	2560.32	2865.12
500	1676.40	1981.20	2286.00	2590.80	2895.60
600	1706.88	2011.68	2316.48	2621.28	2926.08
700	1737.36	2042.16	2346.96	2651.76	2956.56
800	1767.84	2072.64	2377.44	2682.24	2987.04
900	1798.32	2103.12	2407.92	2712.72	3017.52

METRIC CONVERSION TABLES.—*Continued*

MISCELLANEOUS

No.	64ths of an inch to Millimeters	Millimeters to 64ths of an inch	Kilometers to Miles	Miles to Kilometers
1	0.3969	2.5197	0.62137	1.60935
2	0.7938	5.0394	1.24274	3.21869
3	1.1906	7.5590	1.86411	4.82804
4	1.5875	10.0787	2.48548	6.43739
5	1.9844	12.5984	3.10685	8.04674
6	2.3813	15.1181	3.72822	9.65608
7	2.7781	17.6378	4.34959	11.26543
8	3.1750	20.1574	4.97096	12.87478
9	3.5719	22.6771	5.59233	14.48412

No.	Square Inches to Square Centimeters	Square Centimeters to Square Inches	Square Feet to Square Meters	Square Meters to Square Feet	Square Yards to Square Meters	Square Meters to Square Yards
1	6.4516	0.155	0.0929	10.7639	0.8361	1.196
2	12.9032	0.310	0.1858	21.5278	1.6722	2.392
3	19.3548	0.465	0.2787	32.2917	2.5084	3.588
4	25.8064	0.620	0.3716	43.0556	3.3445	4.784
5	32.2581	0.775	0.4645	53.8194	4.1806	5.980
6	38.7097	0.930	0.5574	64.5833	5.0167	7.176
7	45.1613	1.085	0.6503	75.3472	5.8528	8.372
8	51 6129	1.240	0.7432	86.1111	6.6890	9.568
9	58.0645	1.395	0.8361	96.8750	7.5251	10.764

No.	Cubic Centimeters to Cubic Inches	Cubic Inches to Cubic Centimeters	Cubic Meters to Cubic Feet	Cubic Feet to Cubic Meters	Cubic Meters to Cubic Yards	Cubic Yards to Cubic Meters
1	0.061	16.3934	35.316	0.0283	1.308	0.7645
2	0.122	32.7869	70.632	0.0566	2.616	1.5291
3	0.183	49.1803	105.948	0.0849	3.924	2.2936
4	0.244	65.5738	141.264	0.1133	5.232	3.0581
5	0.305	81.9672	176.580	0.1416	6.540	3.8226
6	0.366	98.3607	211.896	0.1699	7.848	4.5872
7	0.427	114.7541	247.212	0.1982	9.156	5.3517
8	0.488	131.1475	282.528	0.2265	10.464	6.1162
9	0.549	147.5410	317.844	0.2548	11.772	6.8807

METRIC CONVERSION TABLES.—*Continued*

POUNDS TO KILOGRAMS

(1 lb. to 99 lbs., advancing by 1 lb.)

Pounds		10	20	30	40	50	60	70	80
	Kilos	Kilos	Kilos	Kilos	Kilos	Kilos	Kilos	Kilos	Kilo
0		4.536	9.072	13.608	18.144	22.680	27.216	31.752	36.28
1	0.4536	4.990	9.526	14.062	18.598	23.134	27.670	32.206	36.74
2	0.9072	5.443	9.979	14.515	19.051	23.587	28.123	32.659	37.19
3	1.3608	5.897	10.433	14.969	19.505	24.041	28.577	33.113	37.64
4	1.8144	6.350	10.886	15.422	19.958	24.494	29.030	33.566	38.10
5	2.2680	6.804	11.340	15.876	20.412	24.948	29.484	34.020	38.55
6	2.7216	7.258	11.794	16.330	20.866	25.402	29.938	34.474	39.01
7	3.1752	7.711	12.247	16.783	21.319	25.855	30.391	34.927	39.46
8	3.6288	8.165	12.701	17.237	21.773	26.309	30.845	35.381	39.91
9	4.0824	8.618	13.154	17.690	22.226	26.762	31.298	35.834	40.37

KILOGRAMS TO POUNDS

(1 Kilo to 99 Kilos, advancing by 1 Kilo)

Kilos		10	20	30	40	50	60	70	8(
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lt
0		22.046	44.092	66.138	88.184	110.230	132.276	154.322	176.
1	2.2046	24.250	46.297	68.343	90.389	112.435	134.481	156.527	178.
2	4.4092	26.455	48.501	70.547	92.593	114.639	136.685	158.731	180.
3	6.6138	28.660	50.706	72.752	94.798	116.844	138.890	160.936	182.
4	8.8184	30.864	52.910	74.956	97.002	119.048	141.094	163.140	185.
5	11.0230	33.069	55.115	77.161	99.207	121.253	143.299	165.345	187.
6	13.2276	35.274	57.320	79.366	101.412	123.458	145.504	167.550	189.
7	15.4322	37.478	59.524	81.570	103.616	125.662	147.708	169.754	191.
8	17.6368	39.683	61.729	83.775	105.821	127.867	149.913	171.959	194.
9	19.84	[illegible]	[illegible]	[illegible]	[illegible]	130.071	152.117	174.163	196.

METRIC CONVERSION TABLES.—*Continued*

POUNDS PER LINEAR FOOT TO KILOS PER LINEAR METER

Lbs. per Foot		10	20	30	40	50	60	70	80	90
					Kilos per Meter					
0		14.882	29.764	44.645	59.527	74.409	89.291	104.172	119.054	133.936
1	1.4882	16.370	31.252	46.133	61.015	75.897	90.779	105.660	120.542	135.424
2	2.9764	17.858	32.740	47.621	62.503	77.385	92.267	107.148	122.030	136.912
3	4.4645	19.347	34.229	49.110	63.992	78.874	93.756	108.637	123.519	138.401
4	5.9527	20.835	35.717	50.598	65.480	80.362	95.244	110.125	125.007	139.889
5	7.4409	22.323	37.205	52.086	66.968	81.850	96.732	111.613	126.495	141.377
6	8.9291	23.811	38.693	53.574	68.456	83.338	98.220	113.101	127.983	142.865
7	10.4172	25.299	40.181	55.062	69.944	84.826	99.708	114.589	129.471	144.353
8	11.9054	26.787	41.669	56.550	71.432	86.314	101.196	116.077	130.959	145.841
9	13.3936	28.276	43.158	58.039	72.921	87.803	102.685	117.566	132.448	147.330

KILOS PER LINEAR METER TO POUNDS PER LINEAR FOOT

Kilos per Meter		10	20	30	40	50	60	70	80	90
					Pounds per Foot					
0		6.720	13.439	20.159	26.879	33.598	40.318	47.037	53.757	60.477
1	0.6720	7.392	14.111	20.831	27.551	34.270	40.990	47.709	54.429	61.149
2	1.3439	8.064	14.783	21.503	28.223	34.942	41.662	48.381	55.101	61.821
3	2.0159	8.736	15.455	22.175	28.895	35.614	42.334	49.053	55.773	62.493
4	2.6879	9.408	16.127	22.847	29.567	36.286	43.006	49.725	56.445	63.165
5	3.3598	10.080	16.799	23.519	30.239	36.958	43.678	50.397	57.117	63.837
6	4.0318	10.752	17.471	24.191	30.911	37.630	44.350	51.069	57.789	64.509
7	4.7037	11.424	18.143	24.863	31.583	38.302	45.022	51.741	58.461	65.181
8	5.3757	12.096	18.815	25.535	32.255	38.974	45.694	52.413	59.133	65.853
9	6.0477	12.768	19.487	26.207	32.927	39.646	46.366	53.085	59.805	66.525

Metric Conversion Tables.—*Continued*

Pounds per Square Inch to Kilograms per Square Millime

Lbs. per Square Inch		10000	20000	30000	40000	50000	60000	70000	800
			Kilos per Square Millimeter						
0000		7.030	14.060	21.090	28.120	35.150	42.180	49.220	56.2
1000	0.703	7.733	14.763	21.793	28.823	35.853	42.883	49.923	56.9
2000	1.406	8.436	15.466	22.496	29.526	36.556	43.586	50.626	57.6
3000	2.109	9.139	16.169	23.199	30.229	37.259	44.289	51.329	58.3
4000	2.812	9.842	16.872	23.902	30.932	37.962	44.992	52.032	59.0
5000	3.515	10.545	17.575	24.605	31.635	38.665	45.695	52.375	59.7
6000	4.218	11.248	18.278	25.308	32.338	39.368	46.398	53.438	60.4
7000	4.922	11.952	18.982	26.012	33.042	40.072	47.102	54.142	61.1
8000	5.625	12.655	19.685	26.715	33.745	40.775	47.805	54.845	61.8
9000	6.328	13.358	20.388	27.418	34.448	41.478	48.508	55.548	62.5

Kilograms per Square Millimeter to Pounds per Square I

Kilos per Square Millimeter		10	20	30	40	50	60	70	80
			Pounds per Square Inch						
0		14223	28446	42670	56893	71116	85339	99563	1137
1	1422	15645	29868	44092	58315	72538	86761	100985	1152
2	2845	17068	31291	45515	59738	73961	88184	102408	1166
3	4267	18490	32713	46937	61160	75383	89606	103830	1180
4	5689	19912	34135	48359	62582	76805	91028	105252	1194
5	7112	21335	35558	49782	64005	78228	92451	106675	1208
6	8534	22757	36980	51204	65427	79650	93873	108097	1223
7	9956	24179	38402	52626	66849	81072	95295	109519	1237
8	11378	25601	39824	54048	68271	82494	96717	110941	1251
9	12801	27024	41247	55471	69694	83917	98140	112364	1265

METRIC CONVERSION TABLES.—*Continued*

POUNDS PER SQUARE FOOT TO KILOS PER SQUARE METER

Lbs. per Square Foot		10	20	30	40	50	60	70	80	90
				Kilos per Square Meter						
0		48.825	97.649	146.474	195.299	244.123	292.948	341.773	390.597	439.422
1	4.8825	53.708	102.532	151.357	200.182	249.006	297.831	346.656	395.480	444.305
2	9.7649	58.590	107.414	156.239	205.064	253.888	302.713	351.538	400.362	449.187
3	14.6474	63.472	112.296	161.121	209.946	258.770	307.595	356.420	405.244	454.069
4	19.5299	68.355	117.179	166.004	214.829	263.653	312.478	361.303	410.127	458.952
5	24.4123	73.237	122.061	170.886	219.711	268.535	317.360	366.185	415.009	463.834
6	29.2948	78.120	126.944	175.769	224.594	273.418	322.243	371.068	419.892	468.717
7	34.1773	83.002	131.826	180.651	229.476	278.300	327.125	375.950	424.774	473.599
8	39.0597	87.885	136.709	185.534	234.359	283.183	332.008	380.833	429.657	478.482
9	43.9422	92.767	141.591	190.416	239.241	288.065	336.890	385.715	434.539	483.364

KILOS PER SQUARE METER TO POUNDS PER SQUARE FOOT

Kilos per Square Meter		10	20	30	40	50	60	70	80	90
				Pounds per Square Foot						
0		2.048	4.096	6.144	8.193	10.241	12.289	14.337	16.385	18.433
1	0.2048	2.253	4.301	6.349	8.398	10.446	12.494	14.542	16.590	18.638
2	0.4096	2.458	4.506	6.554	8.603	10.651	12.699	14.747	16.795	18.843
3	0.6144	2.662	4.710	6.758	8.807	10.855	12.903	14.951	16.999	19.047
4	0.8193	2.867	4.915	6.963	9.012	11.060	13.103	15.156	17.204	19.252
5	1.0241	3.072	5.120	7.168	9.217	11.265	13.313	15.361	17.409	19.457
6	1.2289	3.277	5.325	7.373	9.422	11.470	13.518	15.566	17.614	19.662
7	1.4337	3.482	5.530	7.578	9.627	11.675	13.723	15.771	17.819	19.867
8	1.6385	3.687	5.735	7.783	9.832	11.880	13.928	15.976	18.024	20.072
9	1.8433	3.891	5.939	7.987	10.036	12.084	14.132	16.180	18.228	20.276

METRIC CONVERSION TABLES.—*Continued*

NET TONS (OF 2000 LBS.) PER SQUARE FOOT TO KILOS PER SQUARE METER

Net Tons per Square Foot		10	20	30	40
	Kilos per Square Meter				
0		97,649	195,299	292,948	390,597
1	9,765	107,414	205,064	302,713	400,362
2	19,530	117,179	214,829	312,478	410,127
3	29,295	126,944	224,594	322,243	419,892
4	39,060	136,709	234,359	332,008	429,657
5	48,825	146,474	244,124	341,773	439,422
6	58,590	156,239	253,889	351,538	449,187
7	68,355	166,004	263,654	361,303	458,952
8	78,120	175,769	273,419	371,068	468,717
9	87,885	185,534	283,184	380,833	478,482

GROSS TONS (OF 2240 LBS.) PER SQUARE FOOT TO METRIC TONS (OF 1000 KILOS) PER SQUARE METER

Gross Tons per Square Foot	Metric Tons per Square Meter
1	10.937
2	21.873
3	32.810
4	43.747
5	54.684
6	65.620
7	76.557
8	87.494
9	98.431

METRIC TONS (OF 1000 KILOS) PER SQUARE METER TO GROSS TONS OF 2240 LBS.) PER SQUARE FOOT

Metric Tons per Square Meter	Gross Tons per Square Foot
1	0.091
2	0.183
3	0.274
4	0.366
5	0.457
6	0.549
7	0.640
8	0.731
9	0.823

METRIC CONVERSION TABLES.—*Continued*

POUNDS PER CUBIC FOOT TO KILOS PER CUBIC METER

	10	20	30	40	50	60	70	80	90
				Kilos per Cubic Meter					
	160.192	320.385	480.577	640.769	800.962	961.154	1121.346	1281.539	1441.731
6.0192	176.211	336.404	496.596	656.788	816.981	977.173	1137.365	1297.558	1457.750
32.0385	192.231	352.424	512.616	672.808	833.001	993.193	1153.385	1313.578	1473.770
48.0577	208.250	368.443	528.635	688.827	849.020	1009.212	1169.404	1329.597	1489.789
64.0769	224.269	384.462	544.654	704.846	865.039	1025.231	1185.423	1345.616	1505.808
80.0962	240.288	400.481	560.673	720.865	881.058	1041.250	1201.442	1361.635	1521.827
96.1154	256.307	416.500	576.692	736.884	897.077	1057.269	1217.461	1377.654	1537.846
12.1346	272.327	432.520	592.712	752.904	913.097	1073.289	1233.481	1393.674	1553.866
128.1539	288.346	448.539	608.731	768.923	929.116	1089.308	1249.500	1409.693	1569.885
144.1731	304.365	464.558	624.750	784.942	945.135	1105.327	1265.519	1425.712	1585.904

KILOS PER CUBIC METER TO POUNDS PER CUBIC FOOT

Kilos per Cubic Meter		10	20	30	40	50	60	70	80	90
				Pounds per Cubic Foot						
0		0.624	1.248	1.873	2.497	3.121	3.745	4.370	4.994	5.618
1	0.0624	0.686	1.310	1.935	2.559	3.183	3.807	4.432	5.056	5.680
2	0.1248	0.749	1.373	1.998	2.622	3.246	3.870	4.495	5.119	5.743
3	0.1873	0.811	1.435	2.060	2.684	3.308	3.932	4.557	5.181	5.805
4	0.2497	0.874	1.498	2.123	2.747	3.371	3.995	4.620	5.244	5.868
5	0.3121	0.936	1.560	2.185	2.809	3.433	4.057	4.682	5.306	5.930
6	0.3745	0.999	1.623	2.248	2.872	3.496	4.120	4.745	5.369	5.993
7	0.4370	1.061	1.685	2.310	2.934	3.558	4.182	4.807	5.431	6.055
8	0.4994	1.123	1.747	2.372	2.996	3.620	4.244	4.869	5.493	6.117
9	0.5618	1.186	1.810	2.435	3.059	3.683	4.307	4.932	5.556	6.180

METRIC CONVERSION TABLES.—*Continued*

MISCELLANEOUS

No.	Ounces to Grams	Kilograms to Ounces	Net Tons of 2000 Lbs. to Metric Tons of 1000 Kilos	Metric Tons of 1000 Kilos to Net Tons of 2000 Lbs.	Gross Tons of 2240 Lbs. to Metric Tons of 1000 Kilos	M of to of
1	28.3495	35.274	0.9072	1.1023	1.0161	
2	56.6990	70.548	1.8144	2.2046	2.0321	
3	85.0485	105.822	2.7216	3.3069	3.0482	
4	113 3980	141.096	3.6288	4.4092	4 0642	
5	141.7475	176.370	4.5360	5.5115	5.0803	
6	170.0970	211.644	5.4432	6.6138	6.0963	
7	198.4464	246.918	6.3504	7.7161	7.1124	
8	226.7959	282.192	7.2576	8.8184	8.1285	
9	255.1454	317.466	8.1647	9.9207	9.1445	

No.	Kilos per Meter to Lbs. per Yard	Lbs. per Yard to Kilos per Meter	Kilos per Square Centimeter to Lbs. per Square Inch	Lbs. pe Inch to Square (
1	2.0160	0.4961	14.2232	0.
2	4.0317	0.9921	28.4465	0.
3	6.0477	1.4882	42.6697	0.
4	8.0637	1.9842	56.8929	0.
5	10 0794	2.4803	71.1161	0.
6	12 0954	2.9764	85.3394	0.
7	14.1111	3.4724	99.5626	0.
8	16 1271	3.9685	113.7858	0.
9	18.1431	4 4645	128.0090	0.

WIRE PRODUCTS

WIRE RODS

Acid and Basic Open Hearth—high or low carbon, Bessemer low carbon, Crucible and Special Steels, in sizes No. 5 (A. S. & W. gauge) to 1 1/32" diameter, including all intermediate numbers of the A. S. & W. gauge and fractions of an inch in multiples of 1/32. Special sizes and shapes if ordered in quantities sufficient to justify the preparation of special rolls to manufacture them.

Horse Nail Wire Rods—rectangular and round.

Charcoal Iron Rods. Copper Rods.

WIRE

We are prepared to furnish drawn steel wire manufactured from steel of practically every known variety or analysis, including certain alloys, of Round, Square, Square Grooved, Flat, Crescent, Oval and Special Sections, with all finishes, and for all purposes, drawn to any desired gauge. Unless otherwise specified and agreed, our steel wires are drawn to the American Steel & Wire Company's Gauge.

In ordering or requesting quotations on wire it is most important that the purpose for which it is to be used be stated. If intended for any special use liberal working samples of wire previously in use and giving satisfaction should accompany inquiries or orders. Attention is directed especially to the necessity of furnishing liberal samples. Pieces of wire ten gauge and coarser less than twelve inches (30 c/m) long, and finer gauges of corresponding weight are practically useless.

Coiling, Packing, etc.—Our wires are put up in catch weight or exact weight coils, as desired, and shipped bare, oiled, wrapped in paper or burlap or both, or packed in barrels or cases lined with paper or tin, according to the nature and size of the wire, the weight of the coils, etc., etc. Fine wires are put up on spools holding ½ ounce each upward. In the following pages will be found a list of the various kinds of wire manufactured by the American Steel & Wire Company, with information as to the usual gauges supplied, mode of packing, etc., etc. Prices will be quoted on receipt of definite inquiries, with full particulars.

Galvanizing.—Special attention is called to the quality of the galvanizing. The American Steel & Wire Company uses only the highest grade of spelter (zinc) of its own production, and by means of improved continuous processes secures a bright, clean, smooth and lasting coating which does not crack nor scale off.

STANDARD WIRE GAUGES

Number of Gauge	Thickness in Decimals of an Inch					
	American Steel and Wire Gauge (A. S. &W.)	*Birmingham Wire Gauge (B. W. G.)	British Imperial Standard Wire Gauge (I.S.W.G.)	†American Wire Gauge (B. & S.)	Paris Gauge (J. de P.)	Westphalia Gauge
0000000	.4900		.500			
000000	.4615		.464	.5800		
00000	.4305		.432	.5165		
0000	.3938	.454	.400	.4600		
000	.3625	.425	.372	.40964		
00	.3310	.380	.348	.3648	(PP) .0157	
0	.3065	.340	.324	.32486	(P) .0196	
1	.2830	.300	.300	.2893	.0236	.0236
2	.2625	.284	.276	.25763	.0275	.0270
3	.2437	.259	.252	.22942	.0314	.0300
4	.2253	.238	.232	.20431	.0354	.0314
5	.2070	.220	.212	.18194	.0393	.0350
6	.1920	.203	.192	.16202	.0433	.0393
7	.1770	.180	.176	.14428	.0472	.0441
8	.1620	.165	.160	.12849	.0512	.0472
9	.1483	.148	.144	.11443	.0551	.0512
10	.1350	.134	.128	.10189	.0590	.0551
11	.1205	.120	.116	.090742	.0630	.0614
12	.1055	.109	.104	.080808	.0708	.0653
13	.0915	.095	.092	.071961	.0787	.0724
14	.0800	.083	.080	.064084	.0866	.0803
15	.0720	.072	.072	.057068	.0944	.0866
16	.0625	.065	.064	.05082	.1062	.0944
17	.0540	.058	.056	.045257	.1181	.1023
18	.0475	.049	.048	.040303	.1338	.1150
19	.0410	.042	.040	.03589	.1535	.1338
20	.0348	.035	.036	.031961	.1732	.1512
21	.03175	.032	.032	.028462	.1929	.1653
22	.0286	.028	.028	.025347	.2126	.1830
23	.0258	.025	.024	.022571	.2322	.2145
24	.0230	.022	.022	.0201	.2520	.2346
25	.0204	.020	.020	.0179	.2756	.2756
26	.0181	.018	.018	.01594	.2992	.2992
27	.0173	.016	.0164	.014195	.3228	.3464
28	.0162	.014	.0148	.012641	.3464	.3700
29	.0150	.013	.0136	.011257	.3700	.3937
30	.0140	.012	.0124	.010025	.3937	
31	.0132	.010	.0116	.008928		
32	.0128	.009	.0108	.00795		
33	.0118	.008	.0100	.00708		
34	.0104	.007	.0092	.006304		
35	.0095	.005	.0084	.005614		
36	.0090	.004	.0076	.005		
37	.0085		.0068	.004453		
38	.0080		.0060	.003965		
39	.0075		.0052	.003531		
40	.0070		.0048	.003144		

*Also known as Stub's Gauge.

†Also known as Brown & Sharpe's Gauge.

STANDARD WIRE GAUGES.—*Continued*

Number of Gauge .S. & W.)	Thickness in Millimeters American Steel and Wire Gauge	*Birmingham Wire Gauge (B.W.G.)	British Imperial Standard Wire Gauge (I.S.W.G.)	†American Wire Gauge (B. & S.)	Paris Gauge (J. de P.)	Westphalia Gauge	Number of Gauge
0000000	12.45		12.699				0000000
000000	11.72		11.785	14.73			000000
00000	10.93		10.972	13.12			00000
0000	10.00	11.532	10.159	11.68			0000
000	9.208	10.795	9.448	10.40			000
00	8.407	9.652	8.839	9.266	(PP).400		00
0	7.785	8.636	8.229	8.255	(P) .500		0
1	7.188	7.620	7.620	7.348	.600	.60	1
2	6.668	7.213	7.010	6.543	.700	.68	2
3	6.190	6.579	6.400	5.827	.800	.76	3
4	5.723	6.045	5.892	5.189	.900	.80	4
5	5.258	5.588	5.384	4.620	1.000	.88	5
6	4.877	5.156	4.876	4.115	1.100	1.00	6
7	4.496	4.572	4.470	3.665	1.200	1.12	7
8	4.115	4.191	4.064	3.264	1.300	1.20	8
9	3.767	3.759	3.657	2.906	1.400	1.30	9
10	3.429	3.404	3.251	2.588	1.500	1.40	10
11	3.061	3.048	2.946	2.304	1.600	1.56	11
12	2.680	2.769	2.641	2.052	1.800	1.66	12
13	2.324	2.413	2.336	1.829	2.000	1.84	13
14	2.032	2.108	2.032	1.628	2.200	2.04	14
15	1.829	1.829	1.828	1.450	2.400	2.20	15
16	1.588	1.651	1.625	1.290	2.700	2.40	16
17	1.372	1.473	1.421	1.151	3.000	2.60	17
18	1.207	1.245	1.218	1.024	3.400	2.92	18
19	1.041	1.067	1.016	.9119	3.900	3.40	19
20	.8839	.8886	.9144	.8128	4.400	3.84	20
21	.8052	.8128	.8124	.7239	4.900	4.20	21
22	.7264	.7109	.7109	.6426	5.400	4.65	22
23	.6553	.6347	.6093	.5740	5.900	5.45	23
24	.5842	.5585	.5585	.5105	6.400	5.96	24
25	.5182	.5078	.5078	.4547	7.000	7.00	25
26	.4597	.4570	.4570	.4039	7.600	7.60	26
27	.4394	.4062	.4166	.3607	8.200	8.80	27
28	.4115	.3555	.3759	.3200	8.800	9.40	28
29	.3810	.3300	.3454	.2870	9.400	10.00	29
30	.3556	.3046	.3150	.2540	10.000		30
31	.3353	.2539	.2946	.2268			31
32	.3251	.2286	.2743	.2019			32
33	.2997	.2031	.2540	.1798			33
34	.2642	.1777	.2337	.1600			34
35	.2413	.1269	.2134	.1425			35
36	.2286	.1016	.1930	.1270			36
37	.2159		.1727	.1130			37
38	.2032		.1524	.1006			38
39	.1905		.1321	.08966			39
40	.1778		.1219	.07976			40

*Also known as Stub's Gauge.

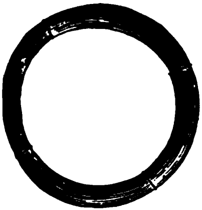
†Also known as Brown & Sharpe's Gauge.

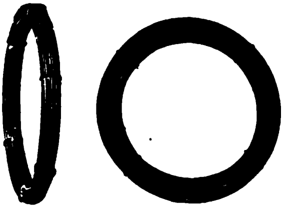
SMOOTH STEEL WIRE

SIZE, WEIGHT AND LENGTH OF WIRE

Amer. Steel and Wire Gauge	Diameter		Approximate Length of 100 Lbs., Feet	Approximate Weight		
	Decimal of an Inch	Millimeters		100 Feet, Pounds	One Mile, Pounds	1000 Meters, Kilos
000	.3625	9.2075	285	35.05	1851	521
00	.3310	8.407	342	29.22	1543	435
0	.3065	7.785	399	25.06	1323	373
1	.2830	7.185	468	21.36	1128	318
2	.2625	6.668	544	18.38	970	273
3	.2437	6.190	631	15.84	836	235
4	.2253	5.723	738	13.54	715	201
5	.2070	5.258	875	11.43	603	170
6	.1920	4.877	1017	9.832	519	146
7	.1770	4.496	1197	8.356	441	124
8	.1620	4.115	1429	7.000	369	104
9	.1483	3.767	1705	5.866	309	87
10	.1350	3.429	2057	4.861	256	72
11	.1205	3.061	2582	3.873	204	57
12	.1055	2.68	3369	2.969	156	44
13	.0915	2.324	4478	2.233	117	33
14	.0800	2.032	5858	1.707	90	25.352
15	.0720	1.829	7232	1.383	73	20.563
16	.0625	1.588	9598	1.042	55	15.493
17	.0540	1.372	12860	.7778	41	11.560
18	.0475	1.207	16620	.6018	31.77	8.950
19	.0410	1.041	22300	.4484	23.67	6.668
20	.0348	.8839	30960	.3230	17.00	4.789
21	.0317	.8052	37310	.2680	14.15	3.986
22	.0286	.7264	45840	.2182	11.52	3.245
23	.0258	.6553	56330	.1775	9.37	2.640
24	.0230	.5842	70870	.1411	7.45	2.100
25	.0204	.5182	90090	.1110	5.86	1.651
26	.0181	.4597	114400	.08738	4.61	1.300
27	.0173	.4394	125300	.07983	4.215	1.187
28	.0162	.4115	142900	.07	3.696	1.411
29	.0150	.3810	166600	.06001	3.169	.893
30	.0140	.3556	191300	.05228	2.76	.777
31	.0132	.3353	215200	.04647	2.454	.689
32	.0128	.3251	228800	.04370	2.307	.650
33	.0118	.2997	269300	.03714	1.961	.552

FENCE WIRES


Single Coil
(Ordinary Round Section)


Single Coil
(Square Section)

Nested Coil
(Square Section)

PLAIN, GALVANIZED AND BLACK VARNISHED FENCE WIRES

We offer these in hard, medium, soft or extra soft quality in any desired auge, in neat, securely bound catch weight or exact weight bundles, single or ested, as illustrated above. Catch weight bundles generally consist of single ontinuous lengths bound separately and, where necessary, two or more such ngths bound together into larger bundles. Exact weight bundles of 14 A.S. nd W. gauge and coarser sizes can be furnished consisting of continuous ngths electrically welded when more than one piece is required to make up e specified weight.

In case a soft ductile wire is required our special extra soft quality should e ordered and care should be taken always to specify "Extra Soft" as otherise our standard hard fence wire quality is supplied.

For use in vineyards our extra soft quality of galvanized wire is particularly uitable; in fact this quality has given entire satisfaction wherever it has been sed throughout the world.

ALVANIZED COILED SPRING STEEL FENCE WIRE

This class of wire is particularly suitable for main strands of woven wire ence or for use in climates where low temperatures are encountered or where ide fluctuations occur. It is made exclusively of a special class of high rade steel and so coiled that all strains of setting up are borne by the tension urves. It is made in gauges 7 to 12 inclusive and put up regularly in catch eight bundles but can be furnished, if required, in bundles of specific weight.

Gauge	Feet per Pound	Meters per Kilo	Gauge	Feet per Pound	Meters per Kilo
7	11.00	7.392	10	20.00	13.439
8	13.33	8.958	11	24.61	16.537
9	16.70	11.222	12	32.00	21.503

FENCE WIRES.—*Continued*

GALVANIZED HIGH TENSILE OVAL FENCE WIRE

In order to meet the demand for a fence wire of greater resistance than ordinary round galvanized wire the American Steel & Wire Company has developed a quality of Galvanized Oval Fencing Wire, made from High Carbon Steel, which possesses a much greater tensile strength than any of the ordinary grades of round galvanized wire generally used for fencing purposes, and has the additional advantage, that a fence made of oval wire is more visible than if made of round wire of equal weight to a given length. The strength of this wire is such that the size 12x14 (A. S. & W. Gauge) will sustain considerably more weight without breaking than No. 11 ordinary round galvanized wire, and 10x12 than No. 9 round wire. Another very important point is that the Galvanized High Tensile Oval Fence Wire is not affected by expansion and contraction due to variations in temperature to the same extent as the ordinary grades of galvanized wire. Special attention is given to the quality of the galvanizing, the coating of spelter being equal to that of the best grades of telegraph wire. This superior galvanizing renders this quality of wire particularly suitable for use where the fencing is exposed to unusually trying atmospheric conditions, such as exist, for instance, in proximity to salt water. The use of this wire insures a fence of great durability, avoiding the necessity of frequent renewals and is consequently more economical than cheaper wires. This wire is furnished in five standard sizes, as stated below, in coils of any desired weight from 50 to 112 lbs. (22½ to 50 kilos) each in one continuous length.

Size (A. S. & W. Gauge)	Tensile Strength		Average Length	
	Lbs.	Kilos	Feet per Pound	Meters per Kilo
No. 13 x 15 (2.32 x 1.83 m m)	950	431	51.00	34.24
No. 12 x 14 (2.68 x 2.03 m m)	1210	550	43.65	29.25
No. 11 x 13 (3.06 x 2.32 m m)	1545	700	35.00	23.50
No. 10 x 12 (3.43 x 2.68 m m)	1825	830	27.20	18.25
No. 9 x 11 (3.76 x 3.06 m m)	2200	1000	20.85	14.00

Fence Wires.—*Continued*

GALVANIZED STEEL BARBED FENCING WIRE

"IOWA"

"WAUKEGAN" "GLIDDEN"

"BAKER PERFECT"

All the above Brands are manufactured by the American Steel & Wire Company, are standard of the world for unexcelled uniformity of quality, and are made of special grade steel insuring the best combination of tensile strength and toughness. The galvanizing is bright, clean and smooth, and will not crack nor scale. The wire is thoroughly coated.

For use in very damp climates or near salt water our *Special* Galvanized Barb Wire is recommended; and where conditions are unusually severe, such as combinations of long rainy seasons near the sea or other bodies of salt water, *Extra* Galvanized Barb Wire should be used.

PACKING

We offer three styles of packing, as follows:

Double cross piece wood spools. See figure 1.
Single cross piece wood spools. See figure 2.
Double cross piece steel spools. See figure 3.

Any weight required from 25 to 125 lbs. (11½ to 56 kilos) net weight.

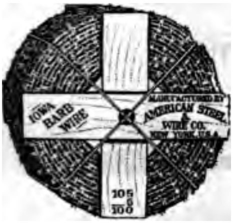

IOWA BARB WIRE
MANUFACTURED BY AMERICAN STEEL & WIRE CO. NEW YORK, U.S.A.
105
100

Fig. 1
Double Cross-piece

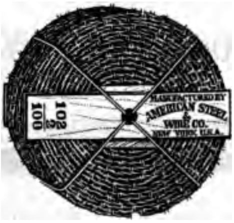

102
100
MANUFACTURED BY AMERICAN STEEL & WIRE CO. NEW YORK, U.S.A.

Fig. 2
Single Cross-piece

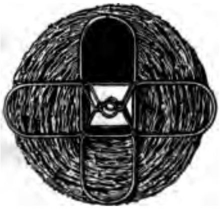


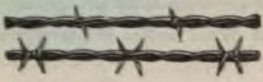
Fig. 3
Steel Spool

Spools stained different colors as required.

GALVANIZED STEEL BARBED FENCING WIRE.—*Continued*

"WAUKEGAN" BARBED WIRE

WAUKEGAN CHIEF

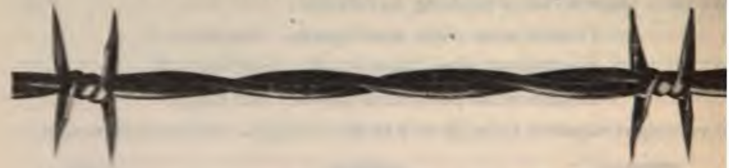


This is the highest priced but most effici and economical barb wire manufactured.

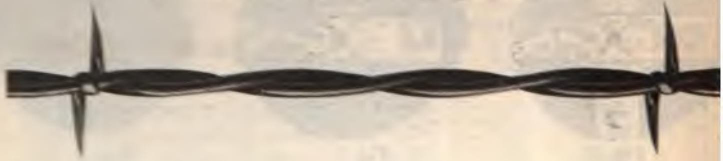
Points of Superiority: Much greater runn length in proportion to given weight and ga of main strands than any other make; ri short, sharp, tightly locked barbs effective w cattle but not destructive; high breaking stra bright and thorough galvanizing.

"WAUKEGAN" Barb Wire is always suppl on red spools bearing the "Waukegan Chi brand. None other is genuine.

"WAUKEGAN" FOUR-POINT



"WAUKEGAN" TWO-POINT

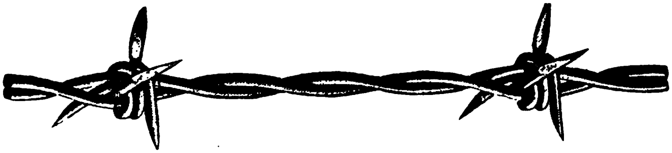


For particulars of gauges, distance between barbs and approximate measu ment per pound and per kilo, see table on page 39.

Galvanized Steel Barbed Fencing Wire.—*Continued*

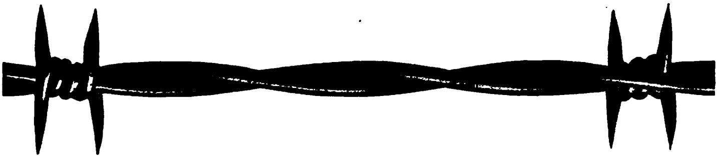
"IOWA" BARB WIRE

(Four-Point)



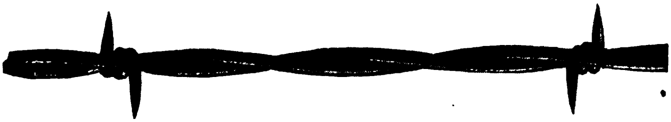
The genuine "Iowa" Barb Wire is manufactured exclusively by the American Steel & Wire Company, and is the most effective barb wire in the world. Has been manufactured and widely sold for upwards of forty years. Universally known. Distinctive features: high breaking strain; long effective barbs interlocked between and around both main strands; latter containing tension curves which equalize contraction and expansion resulting from temperature changes. Fences constructed of this wire maintain their position better than any others.

"GLIDDEN" FOUR-POINT



Our "Glidden" Brand of Four-Point Barbed Wire has been shipped to all parts of the world for many years past. Its merits are well established. Its distinctive feature is that the barbs are wrapped around one strand only.

"GLIDDEN" TWO-POINT

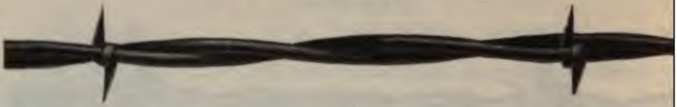


"Glidden" Two-Point is the oldest and best known form of Two-Point Barb Wire. Barbs are wrapped around one strand only.

For particulars of gauges, distance between barbs and approximate measurement per pound and per kilo, see table on page 39.

GALVANIZED STEEL BARBED FENCING WIRE.—*Continued*

"BAKER PERFECT"



Manufactured exclusively by American Steel & Wire Company.

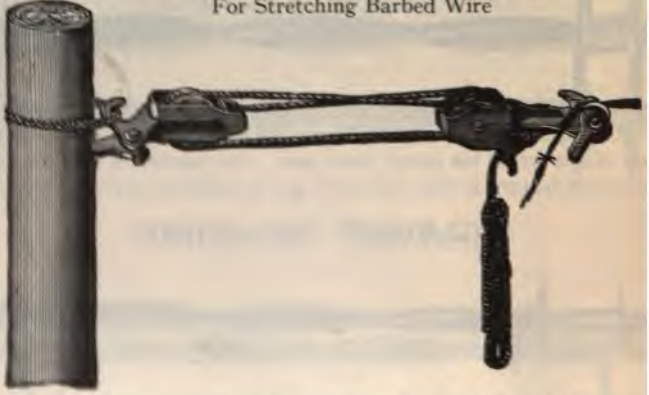
Special attention is called to this brand of Barbed Wire. The stran of the usual size and weight, but the barbs are made of Flattened with rounded edges, and are cut short and sharp, thus giving great str and efficiency, with less weight.

NOTE.—The barbs are not made from Sheet Metal, but of Flattened W

For particulars of gauges, distance between barbs and approximate me ment per pound and per kilo, see table on page 39.

"IOWA" TACKLE STRETCHER

For Stretching Barbed Wire



One of the best and simplest Stretchers in the market. It adjusts works at either end of the fence, at either side of the post and either si It can also be used for splicing.

GALVANIZED STEEL BARBED FENCING WIRE.—*Continued*

COMPARATIVE TABLE SHOWING THE APPROXIMATE MEASUREMENT PER POUND AND PER KILO OF OUR VARIOUS STYLES AND GAUGES OF BARBED WIRE.

STYLE Number of Points and Distance between Barbs			GAUGE OF WIRE							
			No. 12		No. 12½		No. 13		No. 14	
			Feet per Lb.	Meters per Kilo	Feet per Lb.	Meters per Kilo	Feet per Lb.	Meters per Kilo	Feet per Lb.	Meters per Kilo
aukegan,"	2 pt. 5″	(127 m/m)	.....	.....	18.85	12.67	.....	.....	28.00	18.81
aukegan,"	2 pt. 3″	(76 m/m)	.....	.....	18.20	12.23	.....	.....	26.00	17.47
aukegan,"	4 pt. 6″	(152 m/m)	.....	.....	18.20	12.23	.....	.....	24.50	16.46
aukegan,"	4 pt. 3″	(76 m/m)	.....	.....	16.50	11.08	.....	.....	22.00	14.78
wa,"	4 pt. 6″	(152 m/m)	14.03	9.43	.....	.....	.....	.....	22.85	15.36
wa,"	4 pt. 5″	(127 m/m)	13.11	8.81	.....	.....	.....	.....	21.62	14.53
wa,"	4 pt. 3″	(76 m/m)	11.76	7.90	.....	.....	.....	.....	18.82	12.65
idden,"	2 pt. 5″	(127 m/m)	15.68	10.54	.....	.....	.....	.....	24.50	16.46
idden,"	2 pt. 3″	(76 m/m)	14.54	9.77	.....	.....	.....	.....	20.90	14.04
idden,"	4 pt. 6″	(152 m/m)	15.09	10.14	.....	.....	17.85	12.00	24.00	16.13
idden,"	4 pt. 3″	(76 m/m)	12.90	8.67	.....	.....	15.15	10.18	18.87	12.68
idden,"	4 pt. 2½″	(63 m/m)	11.51	7.73	.....	.....	.....	.....	.....	.....
aker Perfect,"	2 pt. 5″	(127 m/m)	16.49	11.08	.....	.....	.....	.....	.....	.....
aker Perfect,"	2 pt. 3″	(76 m/m)	15.68	10.54	.....	.....	.....	.....	.....	.....

NOTE.—The above measurements are approximate and not guaranteed. e sell Barbed Wire by weight only and do not guarantee any particular gth to a given weight.

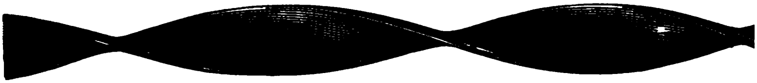
BARBLESS FENCING

Barbless Strands are furnished for use in connection with city lawns, g lots, horse pastures and top strands on barbed wire fences.

Packed on wooden reels, like Barbed Wire. These Strands are all hea alvanized.

Two-Ply Twisted Galvanized Barbless Fencing
Sizes, 11 to 14 (A. S. & W. Gauge), inclusive.

Also Three-Ply, Four-Ply, Five-Ply and Six-Ply Twisted Barbless Fencing. Sizes 7 to 14 (A. S. & W. Gauge), inclusive.



Galvanized Twisted Ribbon Strand, Barbless Fencing
½ inch wide, No. 17 gauge, extra galvanized

Average measurement, 10 feet to one pound (6.72 meters per kilo).

This style of fencing is capable of wonderful resistance, owing to th strength obtained by the size of the wire and method of construction.

It makes a fence which can be plainly seen from a distance, and w elasticity imparted by the twist, no sagging can occur if properly put up

Special square-top staples and clasps for splicing furnished.

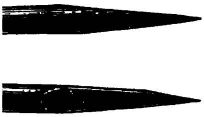
Put up on spools of 100 lbs. (45.36 kilos) net.

STEEL WIRE STAPLES

Staples with slice points, for Fencing, Poultry Netting and mis purposes, are furnished in gauges 6 to 16 inclusive, in any desired le ⅝ to 2½ in. (approximately 16 to 63 m/m) inclusive, either bright, or tinned.

STEEL WIRE STAPLES.—*Continued*

y Fence Staples, as illustrated below, are usually furnished in the tioned lengths, No. 9 gauge, galvanized or bright. Also made of , 11, 12 and 13 gauge wire. Unless otherwise specified, No. 9 gauge l Staples will be understood.



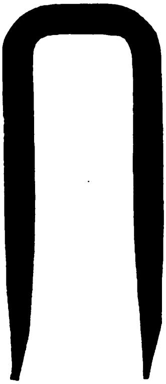
: of 1¼" Ordinary 'ence Staple

Length		Approximate Number to the Pound No. 9 Gauge
Inches	m/m	
⅞	22	120
1	25	108
1⅛	29	96
1¼	32	87
1½	38	72
1¾	45	65
2	51	58

ar or soft-wood posts use 1½ or 1¾ inch staples. d-wood posts use 1¼ inch staples.

BON OR SQUARE TOP STAPLES

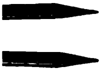
pling Flat Twisted Ribbon Fencing (see page 40) l½ in. (38 m/m), 1¾ in. (45 m/m), and 2 in. (51 ;ths, No. 9 gauge wire.



Ribbon or Square Top Staple

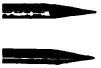
POULTRY NETTING STAPLES

Made from No. 14 Galvanized Wire

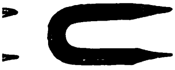


1-in.

⅞-in.



¾-in.



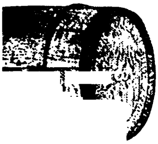
⅝-in.

Length		Approximate Number to the Pound
Inch	m/m	
¾	19	480
⅞	22	416
1	25	352

WIRE HOOP STAPLES

Made from No. 14 Galvanized Wire
For fastening Wire Hoops on Barrels, Casks, etc.

Length		Approximate Number to the Pound
Inch	m/m	
½	13	610
⅝	16	568



Staples are packed in strong wooden kegs of 100 pounds (45.5 kilos), 112 pounds (50.8 kilos), or 50 kilos, net; also in boxes of 10 pounds (4.54 kilos), and 25 pounds (11.34 kilos), in bulk, and in paper packages of various weights for which corresponding extras are charged.

STEEL MARKET WIRE FOR GENERAL MANUFACTURING AND MERCHANT USES

CLASSES

Baling and Binding Wire, annealed high or low carbon.
Bolt Wire, annealed or bright.
Bookbinder Wire, bright, coppered, liquor finish or tinned, flat or round.
Broom Wire, tinned.
Can Key Wire, bright or coppered.
Chain Wire, ordinary or welding quality.
Fence Wire, annealed plain, galvanized or varnished.
Mattress Wire, coppered, liquor finish, galvanized or tinned.
Nail Wire, bright hard or soft.
Netting Wire, bright or liquor finish annealed.
Oil Can Wire, galvanized.
Pail Bale Wire, galvanized or tinned.
Rivet Wire, annealed bright or bright soft.
Screw Wire suitable for large or small heads, cut or rolled threads.
Stitching Wire, coppered, liquor finish or tinned, flat or round.
Tinmans Wire, bright hard or soft.
Weaving Wire, hard or soft.
Welding Wire for electric or ordinary heat processes.

FINISHES

Black	Black Annealed	Coppered	Liquor	Tinned
Bright	Bright Annealed	Galvanized	Finished	Varnished

TEMPERS

Low Carbon Basic Open Hearth or Bessemer Common Wires

Hard	(Drawn hard from the rod or with as little process annealing as necessary to produce the required size.)
Medium Hard	(Partially annealed so as to combine maximum resiliency, tensile strength and toughness, only moderately pliable.)
Soft	(Thoroughly annealed suitable for baling, binding and other uses where high degree of pliability and toughness are required with moderate tensile strength.)
Extra Soft	(Thoroughly annealed, very soft and pliable, lowest degree of tensile strength in our grades of steel.)
Bright Soft	(Hard drawn from rod, annealed and cleaned and given one light draft. Combines maximum ductility and toughness with the bright finish of hard drawn wire.)

SPRING WIRES

Acme Spring Wire, black and coppered.
Crown Spring Wire, black and coppered.
Premier Spring Wire, black, coppered, galvanized and tinned; round and square.
Music Steel Spring Wire, polished, galvanized, coppered and tinned.
Tempering Spring Wire. All kinds of wire for Machine, Motor and Firearm Springs tempered and untempered.

MUSIC WIRE

Piano Wire, "Perfected" and "Crown" brands; polished, tinned and galvanized.

Covering Wire, plain, plated and coppered steel; and polished copper.

SPECIAL AND MISCELLANEOUS WIRES

(NOTE.—In ordering or requesting quotations on wire it is most important that the purpose for which it is to be used be stated. If intended for any special use liberal working samples of wire previously in use and giving satisfaction should accompany inquiries or orders. Attention is directed especially to the necessity of furnishing liberal samples. Pieces of wire ten gauge and coarser less than twelve inches (30 c/m) long, and finer gauges of corresponding weight are practically useless.)

Aeroplane Wires.
Armature Binding Wire.
Automobile Spoke Wire.
Awl Steel Wire.
Belt Hook Wire.
Bicycle Spoke Wire.
Bifurcated Rivet Wire.
Billiard Cushion Wire.
Bird Cage Wire.
Bolt Wire.
Bonnet Wire.
Bookbinder Wire.
Bottling Wire.
Brace Rods.
Brace Wire.
Bridge Rivet Wire.
Bright C. Satin Finishing Wire.
Bright T. P. Satin Finishing Wire.
Broom Wire.
Brush Wire.
Buckle Wire.
Cable Armor Wire, galvanized.
Calk Pin Wire.
Can Key Wire.
Card Wire, round, single convex, double convex and angular; black, bright, and tinned tempered, and brass.
Case Hardening Wire.
Cast Steel Wire, bright, bright annealed, annealed and cleaned, tempered.
Chain Rivet Wire.
Chain Wire.
Charcoal Iron Wire, bright, annealed and cleaned, extra bright.
Clip Wire.
Clock Gong Wire.
Clock Rivet Wire.
Clothes Pin Wire.
Coiled Spring Fence Wire.
Comb Pin Wire.
Concrete Reinforcing Wire.
Core Wire.
Cotter Wire, half round.
Cotton Tie Wire.
Crescent Shaped Wire.
Crimping Wire.
Curtain Spring Wire, tempered.
Cushion Wire.
Dipped Pin Wire.
Drapery Tinned Wire.
Eye Glass Wire.
Fish Hook Wire.
Florists' Wire.
Gill Pin Wire.
Grape Tie Wire.
Gun Barrel Stock.
Gun Ribs.
Gun Screw Wire.
Hackle Pin Wire.
Hair Pin Wire.
Hair Spring Wire.
Hat Wire.
H. B. Steel Wire.
Heddle Wire, bright, bronze and extra bright.
High Carbon Steel Wires.

SPECIAL AND MISCELLANEOUS WIRES.—*Continued*

Hook and Eye Wire, extra bright.
Horse Card Wire.
Horse Nail Wire.
Hose Binding Wire.
Hutter Wire, bright, tinned, galvanized
Jacquard Wire.
Lace Tip Wire.
Latch or Spring Needle Wire.
Link Wire.
Machine Screw Stock.
Machinery Spring Wire.
Mandolin Wire.
Mantle Wire.
Mat Wire, galvanized.
Nail Wire.
Neck Wire, bright annealed, galvanized annealed, and tinned annealed.
Needle Bar Steel.
Needle Steel Wire.
Netting Wire.
O. D. H. Wire.
Open Point Rivet Wire.
Optical Wires.
Pail Bail Wire.
Pendulum Wire.
Phonograph Needle Wire.
Piano Pin Wire.
Picker Tooth Wire.
Picture Cord Wire.
Pile Wire, tempered, untempered and polished.
Pin Wire.
Pinion Wire.
Pipe Winding Wire.
Pivot Wire.
Poultry Netting Wire.
Pump Rods.
Ramrod Steel.
Reed Wire.
Resistance Wire.
River Crossing Wire.
Rivet Wire, bright, annealed and cleaned.
Rope Wire.
Safety Pin Wire.
Scratch Brush Wire.
Screen Wire.
Screw Wire, bright.
Semaphore Wire.
Sewing Machine Needle Wire.
Shoe Nail Wire.
Shuttle Steel.
Signal Wire.
Spindle Iron Wire.
Spoke Wire.
Spooled Wires, annealed, tinned, g vanized, copper.
Spring Needle Wire.
Square Nail Wire.
Square Spindle Steel.
Stapling Wire.
Stitching Wire.
Surface Gauge Steel.
Tack Wire.
Tag Fastener Wire.
Tag Wire.
Tire Wire, bright, "X. S. A. C." a "Premier" grades.
Toe Calk Wire.
Torpedo Lines.
Tubular Rivet Wire.
Twin Heddle Wire.
Umbrella Wire, tempered.
Weaving Wire, bright, bright annealed, galvanized, tinned.
Welding Wire.

NAIL WIRE

Soft or Hard, Round, Square, Oval, Triangular or Grooved.

Our Hard Nail Wire is made of Bessemer Steel, and while equally tough, will be found much stiffer and stronger than most European made wire, and consequently makes a better nail for either soft or hard wood.

We also furnish a special soft quality particularly suitable for the manufacture of nails with large heads, such as Slate, Clout and Lath Nails, and other special nails.

COLD DRAWN SCREW STOCK

(Manufactured by American Steel & Wire Co.)

Cold Drawn Free Cutting Machine Screw Stock can be supplied in the following dimensions:

Rounds.............. $\frac{3}{16}$ in. to 4$\frac{1}{16}$ in. (4.76 m/m to 103.19 m/m) diameter.
Squares.............. $\frac{3}{16}$ in. to 2$\frac{9}{16}$ in. (4.76 m/m to 65.09 m/m) diameter.
Hexagons............ ¼ in. to 2 in. (6.35 m/m to 50.80 m/m) diameter.
Usual lengths......... 6, 8, 10, 12, 14, 16, 18, 20 and 24 feet (1.839, 2.438, 3.048, 3.658, 4.267, 4.877, 5.486, 6.096 and 7.315 m.).

Other lengths and shapes manufactured to order.

For tables of weights see pages 141 to 145.

COLD DRAWN SPECIAL SHAPE STOCK

Square Wires
Oval Wires
Half Oval Wires
Half Round Wires
Convex Wires
Concave Wires
Corrugated Wires
Crescent Shaped Wires
Angular Wires
Diamond Shaped Wires
Triangular Wires

Cold Drawn Wires and Shapes of Bessemer, Open Hearth, Crucible and Special Steels to order.

We can furnish wire drawn to any shape, in any quality of steel desired. Savings can frequently be effected by using drawn shapes in cases where much machine work is required to shape plain bars for particular uses. Inquiries for odd shapes of every kind are solicited.

ROLLER BEARING RODS

(Manufactured by American Steel & Wire Co.)

Our Roller Bearing Rods are specially made for manufacturers of harvesting machinery, windmills, etc. They are true to gauge, perfectly round, free from pits and blemishes of all sorts and finished with a bright polished surface. Sizes manufactured $\frac{3}{16}$ inch to ½ inch (4.76 to 12.70 m/m) diameter. For tables of weights see page 142.

COLD ROLLED FLAT STEEL WIRES

Anti Rattler Steel
Bed Tube Steel
Bookbinder Wire
Box Bands
Box Strap Wire
Brush Wire
Butcher Blade Steel
Cable Armor Wire
Can Spring Steel
Cartridge Clip Steel
Circlette Wire
Clock Spring Steel
Curtain Spring Wire
Curtain Tube and Ball Steel
Cycle Rim Steel
Door Check Steel
Extra Soft Drawing Steel
Eye Glass Spring Steel
Eye Guard Wire
Fish Wire
Flat Cold Rolled Low Carbon Basic and Bessemer Wires
Flat High Carbon Steel Wires
Gong Bell Steel
Hat Wire
Heddle Steel
Hose Armoring Wire
Knife Blade Steel
Knife Back Steel
Lock Spring Steel
Mat Wire
Nut Stock
Oil Well Measuring Line
Orange Box Bands
Pendulum Steel
Phonograph Spring Steel
Pile Wire
Shade Roller Spring Wire
Shingle Band Wire
Shoe Eyelet Wire
Shoe Pattern Wire
Snap Spring Steel
Staple Wire
Stitching Wire
Umbrella Wire

We can furnish Flat Wire and Steel Strips in coils or cut lengths straig
ed: low carbon steels, width 16 inches (406 m m) down to $\frac{1}{32}$ inch (.794 m
high carbon $4\frac{1}{2}$ inches (11.43 c m) to $\frac{1}{32}$ inch (.794 m m); thicknesses $\frac{3}{16}$
(4.763 m m) to .005 inch (.127 m m); all tempers, from high class spri
dead soft for difficult cupping and drawing, in galvanized, coppered, ti
bronzed, blued or bright finishes, suitable for japanning, oxidizing or ele
plating. We supply Flat Cold Rolled Steel for shaping into all forms of m
facture in automatic machines or otherwise, such as adding machine and
mobile parts, buckles, butts and hinges, buttons, castors, cycle and go
parts, cream separator discs, door knobs, envelope fasteners, gun parts,
work, keys, safety pin caps, sewing machine parts, show case and stove
mings, skates, typewriter parts, wire chair rims, toys, tubes and any dif
or plain forming where flat steel of great ductility, strength, finish and
formity is required.

For further information see "Flat Wire Bulletin" describing many us
Flat Strip Steel which will be furnished on request.

BAND SAW STEEL

We are prepared to furnish a superior quality of steel for making Band Saws, flat; untempered, tempered, tempered and polished; or tempered, polished and colored; in any desired gauge and width up to 3 inches (76 millimeters) wide.

COLD ROLLED STEEL HOOPS

These hoops are of Box Band quality, dead soft, suitable for strapping packing cases, boxes and crates; baling cloth, waste, etc.; bundling shingles and lumber; or reinforcing baskets, hampers and similar containers. Furnished in continuous length coils of approximately 40 to 60 lbs. (18.15 to 27.22 Kilos) each, and 16 in. (406 m/m) inside diameter, with Blued, Bright, Painted, Galvanized or Coppered finish, in widths of $\frac{3}{16}$″ to 2″ (4.76 to 50.8 m/m) inclusive, and in thicknesses of Nos. 23 to 30 B. G., inclusive.

CORSET STEEL, DRESS STAY WIRE, ETC.

Corset Steel, Back Wire, Dress Stay Wire and Corset Bone Wire, tempered or untempered, black or coated, furnished in all desired widths and thicknesses.

The quality of our Corset Steel is of the very best and consequently costs more than the commoner grades manufactured in Europe. Buyers who require and appreciate a superior quality of good temper will find that our Corset Steel, both black and coated, will compare favorably, both as to quality and price, with the best European makes.

Special attention is called to our Coated Corset Steel, which is covered with a composition of aluminum and other metals, which renders it rust proof without affecting its excellent temper.

In ordering Corset Steel or inquiring for prices the dimensions (width and thickness) should be stated either in decimals of an English inch or in millimeters (being careful to state which), as the use of the gauge numbers used by some European manufacturers is liable to give rise to misunderstanding unless their equivalents in millimeters or inches are also stated.

AMERICAN WIRE HOOPS

We furnish two styles of Wire Hoops, the T. S. (Twisted Splice) an Electric Welded.

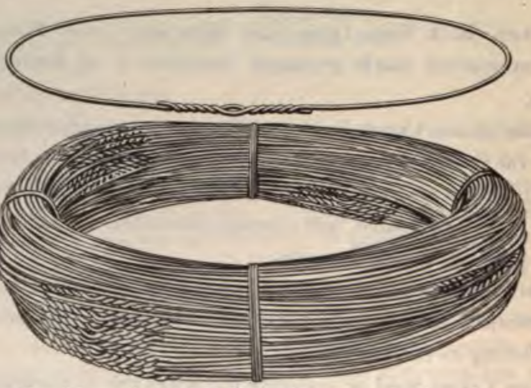
The T. S. style of hoop is used principally for slack cooperage and to small extent as reinforcement in cylindrical concrete work; this style of hoo is objectionable for smooth finished woodenware packages, because th twisted splice mars the package slightly in driving the hoop to place.

The electric welded style of hoop is used on finely finished woodenwar packages and on jacket cans, also for toy hoops, or for any purpose for which wire hoop is wanted.

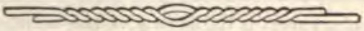
Unless otherwise stated all prices quoted on wire hoops are for brigh finish wire. We can supply either style of hoop in galvanized or coppere finish wire, prices for which will be quoted upon application.

Twisted Splice Wire Hoops are manufactured in any length from 33 t 86½ inches, inclusive, and any gauge of wire from No. 9 to No. 13 gaug inclusive. No. 8 gauge is manufactured in lengths from 40 to 86½ inche inclusive.

Electric Welded Wire Hoops are manufactured in any length fro 12½ to 120 inches, inclusive, in gauges of wire Nos. 6, 7, 8, 9, 10, 11 and 1 and any length from 18 to 120 inches in gauges Nos. 13, 14, 15.



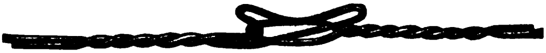
Bundle of American T. S. Wire Hoops ready for shipment
250 Hoops in a bundle



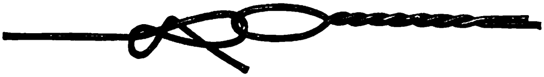
Twisted Splice

PATENT STEEL WIRE BALE TIES

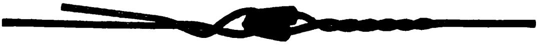
Cross Head



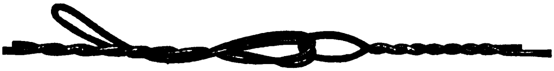
Single Loop



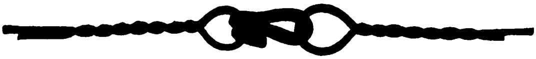
Monitor Grip



Double End Adjustable



Patent Hook



For baling or bundling hay, straw, flax, tow, excelsior, broom corn, wool, cotton, cotton seed hulls, rags, linters, shavings, sawdust, leather, etc. For use in any kind of press; 9 to 16 wire, 5 to 13 feet long. Styles: Cross Head, Single Loop, Monitor Grip, Double End Adjustable, Patent Hook.

Short Length Ties, 2 to 4¾ feet long, and Cross Head Buggy Spring Ties, 12 to 16 inches long.

Can be supplied plain, annealed or galvanized. Unless otherwise specified, annealed always furnished.

Wire Shook Ties for bundling staves, heading, box shooks, veneers, lath, felloes, etc., 17 to 20 wire, 2 to 7 feet, Single Loop.

For further particulars, see special Bale Tie catalogue.

STEEL WIRE NAILS

We can supply every description of Wire Nail made from round, oval, square, triangular or grooved wire. On the following pages are illustrated the principal styles of Nail Heads manufactured by the American Steel & Wire Company, together with a list of the sizes usually supplied to each gauge number. We are always pleased to make any practicable modifications in the general style, shape of heads, points, etc., of our nails, necessary to meet the requirements of any particular trade or foreign market, and shall be glad to receive inquiries for special nails, accompanied by samples and specifications, on which special prices will be quoted on request.

QUALITY

Our Nails are strictly first class in every respect and will be found to be stiffer, stronger and better than Nails made from the softer quality of wire used by many European manufacturers.

FINISHES

Bright, Galvanized, Annealed, Blued, Brass, Tinned and Cement Coated.

GAUGES

We can make to any gauge, but unless otherwise specified and agreed to, the American Steel and Wire Gauge, for particulars of which see pages 30 and 31, will be understood and used.

PACKAGES

Our Nails are usually packed, as required, in strong wooden kegs, containing 100 lbs. (45.4 kilos), 110 lbs. (49.9 kilos), 112 lbs. (50.8 kilos), 133⅓ lbs. (60.5 kilos) or 50 kilos net; or in canvas bags (jute), weighing 56 lbs. (25.4 kilos), 110 lbs. (49.9 kilos), 112 lbs. (50.8 kilos) or 50 kilos each, gross for net.

We can, however, supply kegs, bags or cases of special weights as required by the various foreign and colonial markets, for which special prices will be quoted upon receipt of particulars.

We also pack Nails in paper packages in wooden cases or kegs, as described more fully on page 51.

This is our usual keg for use under ordinary conditions of transportation. It has strong flat steel hoops, securely fastened, on the chimes and steel wire hoops, secured in place by staples clinched crosswise of the grain of the wood, on the bilges. Experience has amply demonstrated the superiority of this style of keg to those with wooden hoops. For shipment to far distant countries involving several transshipments, we use specially constructed kegs, as illustrated on page 51.

STEEL WIRE NAILS.—*Continued*

For shipment to Japan, the East Indies, and other markets requiring heavy packages containing upwards of 130 lbs. (59 kilos) net weight, we furnish kegs similar to the Steel Hoop Keg illustrated on page 50, but with a wooden cleat on each head as additional protection against damage by rough handling during trans-shipment. Kegs containing 112 lbs. (50.8 kilos) or less, net weight, are not furnished with cleats.

NAILS IN PAPER PACKAGES

When desired, any of the nails manufactured by us can be furnished in paper packages, of any desired weight. Our standard weights are stated below.

An extra charge—which will be quoted on application—will be made for all such packages.

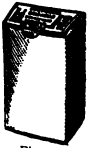


Fig. 1

Nails 4 inches (101.6 m/m) or less in length can be furnished in packages similar to Fig. 1, weighing ¾ lb. (0.34 kilos), 1 lb. (0.454 kilos), 2 lbs. (0.91 kilos) or 1 kilo as desired.

Each package is neatly labeled, showing weight, length, gauge, and style of head.

The paper packages are packed in strong wooden cases each containing 75 lbs. (34 kilos), 100 lbs. (45.4 kilos), 50 kilos or more, according to the package weights.

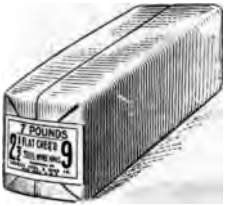


Fig. 2

No order containing less than one case of any one length and gauge can be accepted.

Nails of all lengths can be furnished in packages similar to Fig. 2 or Fig. 3, weighing 5 lbs. (2.27 kilos), 7 lbs. (3.18 kilos), 10 lbs. (4.54 kilos), 14 lbs. (6.35 kilos), 2 kilos, or 5 kilos, as desired.

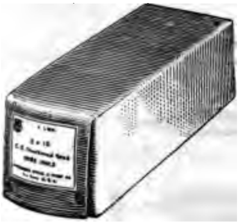


Fig. 3

Each package is plainly marked with weight, length, gauge and style of head.

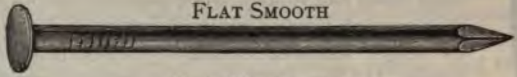
These packages are also packed in strong wooden cases, each containing 100 lbs. (45.4 kilos), 112 lbs. (50.8 kilos), 40 kilos, 50 kilos or more, according to the package weights.

No order containing less than one case of any one length and gauge can be accepted.

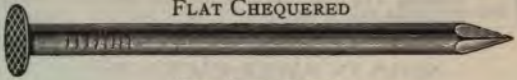
Steel Wire Nails.—*Continued*

STYLES OF NAIL HEADS

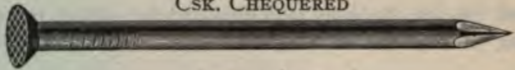
Flat Smooth



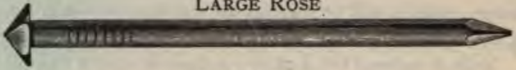
Flat Chequered



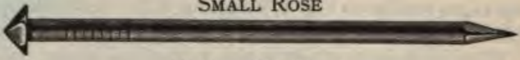
Csk. Chequered



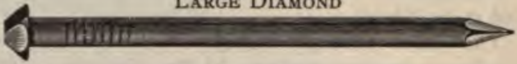
Large Rose



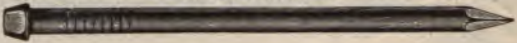
Small Rose



Large Diamond

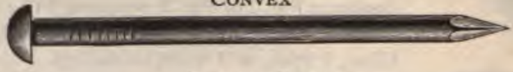


Small Diamond

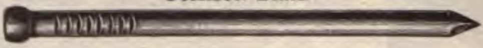


Note.—In ordering Rose or Diamond Heads, state whether Large or S

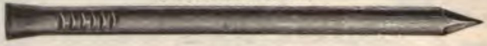
Convex



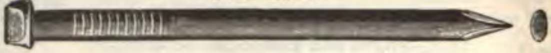
Common Brad



Flooring Brad



Oval Brad



STEEL WIRE NAILS.—*Continued*

Gauges and lengths usually furnished in Wire Nails with Diamond Points.

Flat, Countersunk, Chequered, Smooth, Brad, Convex, Rose or Diamond Heads.

Gauge	Length in Inches																
22	⅜	½															
21	⅜	½															
20	½	⅝															
19	½	⅝	¾														
18	⅝	¾	⅞														
17	¾	⅞	1	1⅛													
16	¾	⅞	1	1⅛	1¼												
15	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾								
14	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼						
13	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½	2⅝	2¾			
12	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½	2⅝	2¾	3	3¼	3½
11	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½	2⅝	2¾	3	3¼	3½				
10	2	2¼	2½	2¾	3	3¼	3½	3¾	4								
9	2¼	2½	2¾	3	3¼	3½	3¾	4	4¼	4½							
8	2¼	2½	2¾	3	3¼	3½	3¾	4	4¼	4½	4¾	5					
7	2¾	3	3¼	3½	3¾	4	4¼	4½	4¾	5	5½	6					
6	3	3¼	3½	3¾	4	4¼	4½	4¾	5	5½	6	6½	7				
5	3½	3¾	4	4¼	4½	4¾	5	5½	6	6½	7						
4	4	4¼	4½	4¾	5	5½	6	6½	7								
3	4½	4¾	5	5½	6	6½	7										
2	5	5½	6	6½	7												
1	5½	6	6½	7													
0	6	6½	7	7½	8												

Nails shorter or longer than specified above can be supplied at special prices when required.

The above list of gauges and lengths applies to the American Steel and Wire Gauge, the Birmingham Wire Gauge (B. W. G.) and to the British Imperial Standard Wire Gauge (S. W. G.). We can also supply nails to the Millimeter Gauge and the Paris Gauge of 1857. Care should be taken to always distinctly state the Gauge required when ordering or requesting quotations.

STEEL WIRE NAILS.—*Continued*

APPROXIMATE NUMBER OF WIRE NAILS PER POUND

A. S. & W. Gauge	3/16	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1½	1¾	2	2¼	2½	2¾	3	3½	4	4½	5	6	7	8	9	10	11	12
2/0										33	27	23	20	18	16	15	14	12	10	9	8	7	6	5	4½	4	3¾	3¼
0										34	29	25	21	19	17	16	15	13	11	10	9	8	7	5½	5	4½	4	3½
1								57	50	45	38	32	28	25	23	21	19	16	14	13	11	10	8	7	6	5½	5	4½
2								65	58	52	44	37	32	29	26	24	22	19	16	14	13	11	9	8	7	6½	6	5½
3						100	87	76	67	60	50	43	38	34	30	28	25	22	19	17	15	13	11	10	8	7½		
4						120	103	90	80	72	60	51	45	40	36	33	30	26	23	20	18	15	13	11	10	9		
5				211	169	141	121	106	94	85	71	60	53	47	42	39	35	30	26	24	21	18	15					
6				247	197	164	141	123	111	99	82	71	62	55	50	45	41	35	31	28	25	21	18					
7				299	239	200	171	149	133	120	100	85	75	67	60	54	50	43	37	33	30	25						
8				345	275	229	197	172	153	137	115	98	86	76	69	62	57	49	43	39	35	29						
9				414	331	276	236	207	184	165	138	118	103	92	82	75	69	59	52	46	41							
10			663	496	397	333	283	248	220	198	165	142	124	110	99	90	83	71	62	55	50							
11			837	628	502	418	359	314	279	251	209	179	157	139	125	114	105	90	79	70								
12			1096	822	658	548	469	411	365	329	274	235	204	182	164	149	137	117	103									
13			1429	1072	857	714	613	536	476	429	357	306	268	238	214	195	178	153										
14		2840	1893	1420	1136	947	811	710	631	568	473	406	350	315	284	258	236											
15		3504	2336	1752	1402	1168	1001	876	778	701	584	500	438	389	350													
16		4571	3048	2280	1828	1523	1305	1143	1015	913	761	653	571	508														
17		6233	4156	3116	2495	2077	1781	1558	1385	1246	1038	890	779															
18		8276	5517	4138	3310	2758	2364	2069	1839	1655	1379	1182																
19		10668	7112	5334	4267	3556	2933	2667	2370	2133	1778																	
20	20000	15000	10000	7500	6000	5000	4400	3750	3333	3000																		
21	23702	17777	11850	8888	7111	5926	5079	4444																				
22	30476	22856	15237	11428	9143	7618																						

These approximate numbers are an AVERAGE only, and the figures given may be varied either way, by changes in the dimensions of the heads or points. Brads and no-head nails will run more to the pound than the table shows, and large or thick headed nails will run less.

Steel Wire Nails.—*Continued*

SLATE NAILS

Gauge	Lengths Furnished, Inches					Diameter Heads Approximate	
13	3/4	7/8	1			1/4	Inch
12	3/4	1	1 1/4			5/16	"
11	1	1 1/4	1 1/2			5/16	"
10	1	1 1/4	1 1/2	1 3/4	2	3/8	"
9	1 1/2	1 3/4	2			7/16	"

CLOUT NAILS

14	1/2	5/8	3/4	7/8	1	1 1/4	1/4	Inch
13	3/4	7/8	1	1 1/4	1 1/2		1/4	"
12	3/4	7/8	1	1 1/4	1 1/2		5/16	"
11	1	1 1/4	1 1/2	1 3/4			5/16	"
10	1	1 1/4	1 1/2	1 3/4	2		3/8	"
9	1 1/2	1 3/4	2				7/16	"

LATH NAILS

14	7/8	1	1 1/4	1 1/2	7/32	Inch
13	1	1 1/4	1 1/2		7/32	"
12	1	1 1/4	1 1/2	1 3/4	9/32	"
11	1 1/4	1 1/2	1 3/4	2	9/32	"

Slate, Clout and Lath Nails supplied with Extra Large Heads when called for, at special prices.

STEEL WIRE NAILS—*Continued*

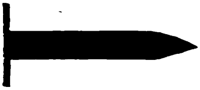
STERILIZED BLUED LATH NAILS

Lathers carry nails in their mouths while at work and it is therefore necessary, from a health standpoint, that they should be free from all injurious substances. Polished or bright nails cannot be made or kept entirely clean.

Sterilized Blued Lath Nails are made in following regular sizes.

1 inch x No. 17 Gauge
1 " x " 16½ "
1⅛ " x " 16 "
1⅛ " x " 15 "

LARGE HEAD BARBED ROOFING NAILS



Gauge	Lengths Furnished, Inches							Diameter Head Approximate
10	¾	⅞	1	1⅛	1¼	1½	1¾	7/16 or ½ Inch
9½	¾	⅞	1	1⅛	1¼	1½	1¾	½ "
9	¾	⅞	1	1⅛	1¼	1½	1¾	½ "
8	¾	⅞	1	1⅛	1¼	1½	1¾	½ "

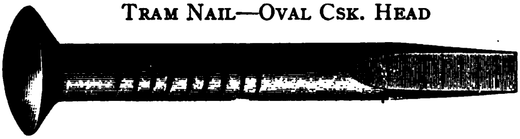
AMERICAN FELT ROOFING NAILS

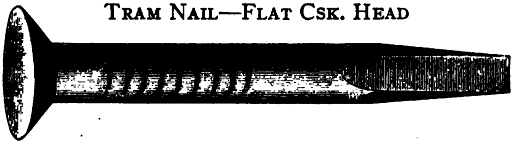
Bright and galvanized.

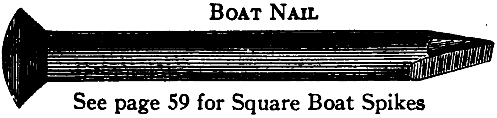
No. 12 gauge; lengths, ¾-inch and 1-inch.

STEEL WIRE NAILS.—*Continued*

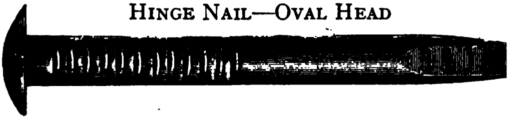
MISCELLANEOUS WIRE NAILS

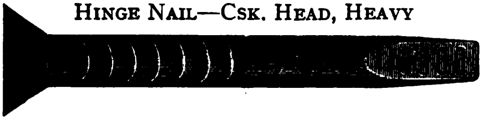

TRAM NAIL—OVAL CSK. HEAD

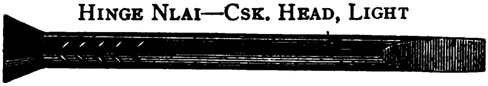

TRAM NAIL—FLAT CSK. HEAD

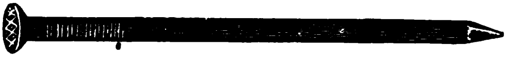

BOAT NAIL

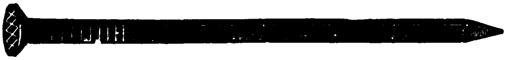
See page 59 for Square Boat Spikes


HINGE NAIL—OVAL HEAD


HINGE NAIL—CSK. HEAD, HEAVY


HINGE NLAI—CSK. HEAD, LIGHT


SQUARE NAIL—CSK. CHEQUERED HEAD


SQUARE GROOVED NAIL—CSK. CHEQUERED HEAD

Square Nails made also with any of the heads shown for Round Nails; lso Triangular and Square Grooved Nails.

Steel Wire Nails.—*Continued*

Miscellaneous Wire Nails.—*Continued*

Clinch Nail—Annealed

Triangular Barbed Nail

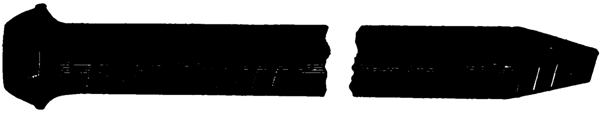
Barbed Car Nail

Also called in some markets "Barbed Roofing Nail."
See page 56 for Large Head Barbed Roofing Nails.

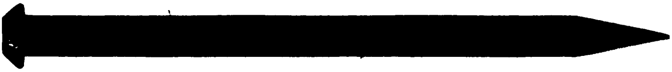
Barbed Dowel Pin

Smooth Double Pointed Dowel

SQUARE BOAT SPIKES



With Chisel Point



With Long Diamond Point

¼ inch square 3 to 8 inches long
5/16 " " 3½ to 8 " "
⅜ " " 3 to 12 " "
7/16 " " 6 to 12 " "
½ " " 6 to 12 " "
⅝ " " 8 to 14 " "

Packed in kegs of 100, 112, 200 or 224 pounds net (about 45, 50, 91 or 102 kilos).

APPROXIMATE NUMBER OF BOAT SPIKES IN A KEG OF 200 POUNDS

Inches Square	Length, Inches					
	3	4	5	6	7	8
⅝						260
½				450	375	335
7/16				600	590	510
⅜	1320	1140	940	800	650	600
5/16	1660	1360	1230	1175	990	880
¼	3000	2375	2050	1825		
	Length, Inches					
	9	10	11	12	14	16
⅝	240	220	205	190	175	160
½	300	275	260	240		
7/16	400	360	320	230		
⅜	525	475				

GALVANIZED SPRING HEAD ROOFING NAILS FOR USE WITH CORRUGATED IRON

The Perfect Nail in the Perfect Package

This nail cannot be equalled for fastening corrugated sheets. The solid spring head is much superior, both in strength and durability to the combination nail and washer.

Before offering this nail for sale, most careful consideration was given to al the climatic and structural conditions under which Spring Head Roofing Nails could be used, and the severity of the tests to which they would be put The result shows the following

ADVANTAGES

Much lower cost as compared to nails used with washers or drive screw nails.

Greater strength with solid spring head than with loose washer attached.

The spring heads adapt themselves to the corrugations, insuring a moisture proof contact.

Thorough protection from action of the elements by heavy galvanizing.

Choice of light, medium, or heavy gauge.

The No. 6 gauge nail can be driven through four thicknesses of 22 gauge sheets.

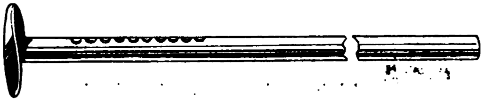
Spring head Roofing Nails should always be driven through sheets, thus avoiding use of punches and resulting over-large perforations and leaky roofs.

SIZES

These nails are manufactured in the following sizes	Approximate Number of Nails per Pound
2 inch x 6 gauge	47
2¼ inch x 6 "	42
2½ inch x 6 "	38
2 inch x 8 "	70
2¼ inch x 8 "	64
2½ inch x 8 "	58
2 inch x 9 "	80
2¼ inch x 9 "	72
2½ inch x 9 "	63

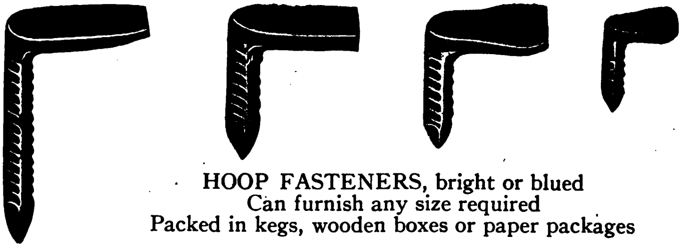
They are put up in packages of 100 nails, or any weight package up to 14 pounds, also in bulk in kegs of from 50 to 140 pounds (25.4 to 63.5 kilos).

SHEET ROOFING FASTENERS

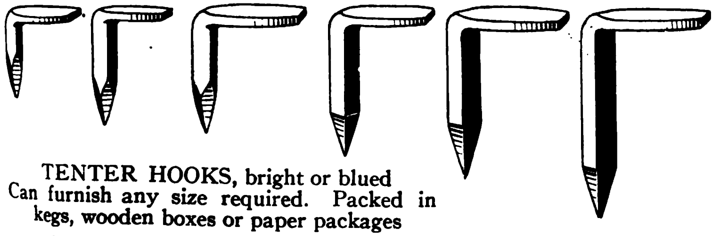


With Curved or Flat Head. (The illustration shows Curved Head). Annealed or Galvanized.

LENGTH		DIAMETER		Approximate Count per Pound
Inches	m/m	Inch	m/m	
6	152	⅛	3.125	46
7	178	⅛	3.125	40
8	203	⅛	3.125	34
9	229	⅛	3.125	31
10	254	⅛	3.125	28
12	305	⅛	3.125	23
14	356	⅛	3.125	20
		A. S. & W. Gauge		
8	203	No. 10	3.429	30
9	229	No. 10	3.429	27
10	254	No. 10	3.429	24
12	305	No. 10	3.429	20

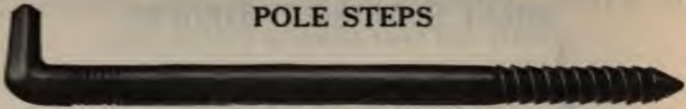


HOOP FASTENERS, bright or blued
Can furnish any size required
Packed in kegs, wooden boxes or paper packages



TENTER HOOKS, bright or blued
Can furnish any size required. Packed in kegs, wooden boxes or paper packages

POLE STEPS



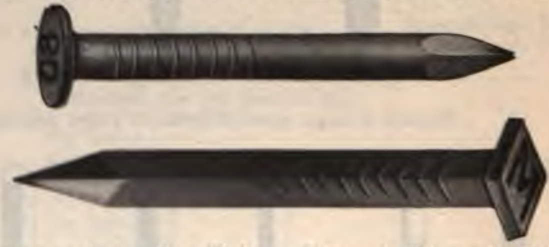
Plain and Extra Galvanized

For the use of Electric Light, Street Railway and Telephone Companies.

Size		Approximate Weight per 1000 Pole Steps, threaded			
		Plain		Galvanized	
Inches	m/m	Pounds	Kilos	Pounds	Kilos
⅝ x 8	16x203	730	331	750	340
⅝ x 9	16x229	780	354	810	367
⅝ x 10	16x254	850	385	880	399
⅝ x 10½	16x267	890	404	930	422
9/16 x 8 ½	14x216	580	263	610	277
9/16 x 9	14x229	620	281	650	295
9/16 x 10½	14x267	710	322	740	336
½ x 9	13x229	510	231	540	245

The above are with our regular heads. Lengths given are measurement over all. Each step carefully threaded with screw thread. Special shape or lengths of heads made to order. A keg of pole steps weighs about 20 pounds (about 91 kilos).

TIE MARKING OR POLE DATING NAILS



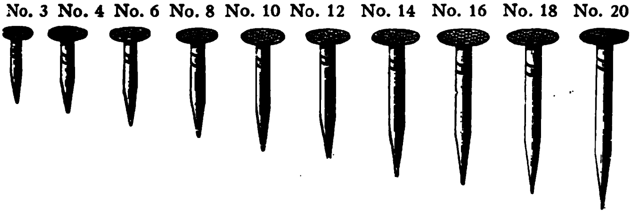
For marking or dating Ties (Railway Sleepers), Telegraph, Telephone ar other Poles, etc.

Furnished bright, galvanized, or tinned; with special letters or figures c the heads, either raised or depressed.

Standard size: Round, 2½-inch x No. 3 gauge; square, 2½-inch x ¼-inc

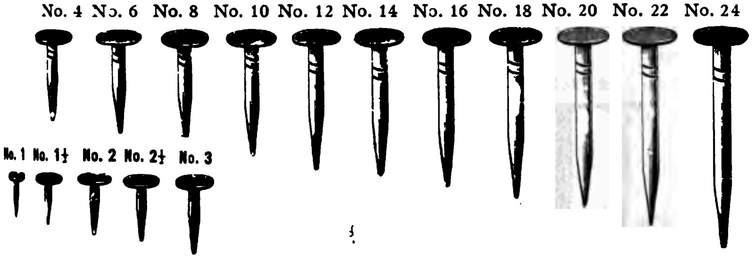
AMERICAN WIRE CARPET TACKS

(Needle Pointed)



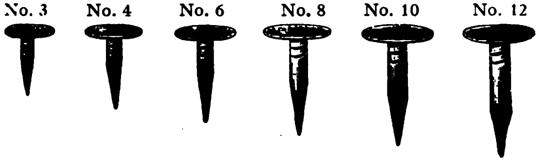
AMERICAN WIRE UPHOLSTERERS' TACKS

(Needle Pointed)



AMERICAN WIRE BILLPOSTERS' OR RAILROAD TACKS

(Large Heads, Needle Pointed)



Polished, Blued, Tinned or Coppered. (Note: Blued Tacks are always supplied unless otherwise specified).

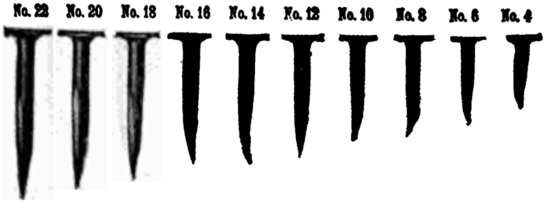
Packed in bulk in kegs of 100 or 112 lbs. net, or in boxes of 25 or 50 lbs. net.

Carpet Tacks and Upholsterers' Tacks, in 2-oz. packages, 100 dozen in a case; ¼-lb. packages, 50 dozen in a case; ½-lb., 1-lb., 5-lb., and 10-lb. packages, packed in cases as desired. Carpet Tacks are also put up in tri-colored 500 count cartons and Toy Barrels, packed in gross or half-gross display cases, as illustrated on page 66.

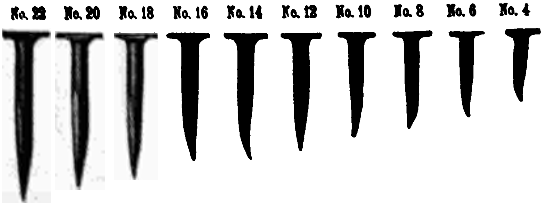
Billposters' Tacks, in ½-lb., 1-lb., 5-lb., and 10-lb. packages, packed in cases as desired.

For table of sizes and weights, see page 65.

"PEERLESS" CARPET TACKS



"PEERLESS" UPHOLSTERERS' TACKS



Polished, Blued, Tinned or Coppered (Note: Blued Tacks are alway plied unless otherwise specified).

Packed in bulk in kegs of 100 or 112 lbs. net, or in boxes of 25 or 50 lb also in 2-oz. packages, 100 dozen in a case: ¼-lb. packages, 50 dozen in a ½-lb., 1-lb., 5-lb., and 10-lb. packages, packed in cases as desired.

"Peerless" Carpet Tacks are also put up in yellow 500 count carton Toy Barrels, packed in gross or half-gross display cases, as illustrated or 66.

For table of sizes and weights, see page 65.

"Peerless" Tacks are suitable for all purposes for which Cut Tacks are and are a decided improvement over Cut Tacks.

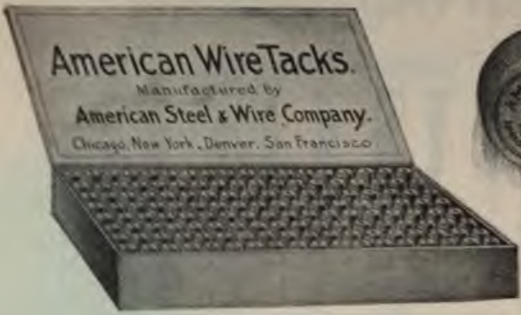
SIZES OF AMERICAN WIRE TACKS

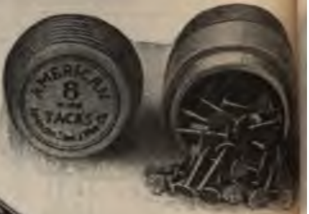
No.	Length		Gauge of Wire (A. S. & W. G.)		
	Inch	m/m	Upholsterers'	Carpet	Bill-Posters
1	7/32	5.55	No. 18	No. 18	....
1½	¼	6.35	" 18	" 18	....
2	9/32	7.14	" 17	" 17	....
2½	5/16	7.94	" 17	" 17	No. 15
3	⅜	9.52	" 16½	" 16½	" 14
4	7/16	11.11	" 16	" 16	" 13½
6	½	12.70	" 15	" 15¼	" 13
8	9/16	14.29	" 15	" 15¼	" 12½
10	⅝	15.88	" 14½	" 15¼	" 12
12	11/16	17.46	" 14½	" 15	" 12
14	¾	19.05	" 14	" 14½	" 11½
16	13/16	20.64	" 14	" 14½	" 11½
18	⅞	22.23	" 13½	" 13½	" 11
20	15/16	23.81	" 13½	" 13½	" 11
22	1	25.40	" 13½	" 13½	....
24	1⅛	28.58	" 13	" 13	....

WEIGHT PER GROSS OF 500 COUNT CARTONS AND TOY BARRELS, AMERICAN WIRE AND "PEERLESS" TACKS

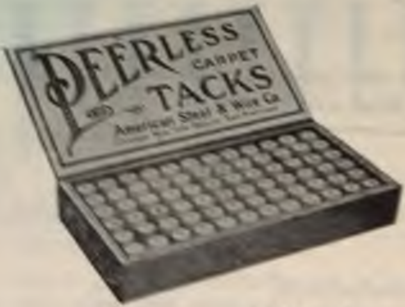
	Net Weight of Tacks		Gross Shipping Weight			
			Half-gross Display Cases		Gross Display Cases	
	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
500 Count Cartons:						
American Wire Tacks, polished or blued, No. 8	44.54	20.20	51.40	23.32	49.40	22.41
American Wire Tacks, polished or blued, assorted Nos. 6, 8 and 10	44.28	20.09	51.16	23.21	49.16	22.30
American Wire Tacks, tinned, No. 8	46.10	20.91	52.98	24.03	50.98	23.12
American Wire Tacks, tinned, assorted Nos. 6, 8 and 10	45.84	20.79	52.72	23.91	50.72	23.00
"Peerless" Tacks, polished or blued, No. 8	50.40	22.86	57.42	26.05	55.42	25.14
"Peerless" Tacks, polished or blued, assorted Nos. 6, 8 and 10	49.90	22.63	56.92	25.82	54.92	24.91
"Peerless" Tacks, tinned, No. 8	52.16	23.66	59.20	26.85	57.20	25.95
"Peerless" Tacks, tinned, assorted Nos. 6, 8 and 10	51.64	23.43	58.68	26.62	56.68	25.71
Toy Barrels, American Wire and "Peerless," polished, blued or tinned	18.00	8.16	30.90	14.02	28.40	12.88

TACKS IN TOY BARRELS


American Wire Tacks.
Manufactured by
American Steel & Wire Company.
Chicago, New York, Denver, San Francisco

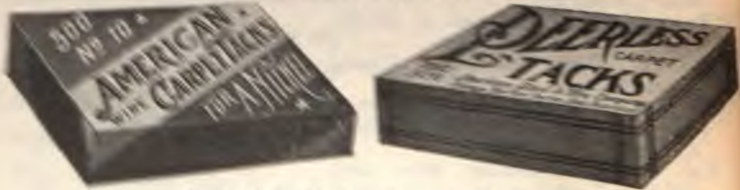


1 Gross Box



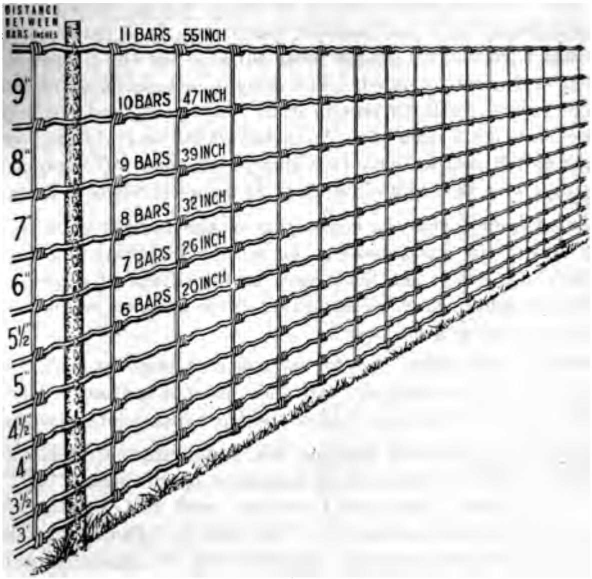
½ Gross Box

500 COUNT CARTONS

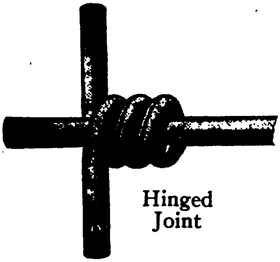


Packed in Display Cases similar to above

WOVEN WIRE FENCING



"AMERICAN" WOVEN WIRE FENCING, DESIGN NO. 1155
with "American" Steel Fence Post (see page 75.)



Hinged
Joint

Tension
Curve

"AMERICAN" WOVEN WIRE FENCING

"American" Woven Wire Fencing is cheap, strong, durable and adapted to all ranch, farm, lawn and paddock purposes. It is made of heavily galvanized steel wire, of the gauges most suitable for the purposes for which the various styles are intended. The designs include an extra heavy Horse and Cattle Fence, made to specification "G" (composed entirely of No. 7 gauge wire) in heights from 18 to 58 inches (0.457 to 1.473 m), and an unexcelled Park and Paddock Fence (see illustration page 70) composed entirely of No. 9 gauge wire, in heights from 61 to 88 inches (1.549 to 2.235m).

The hinged joint forms the connection of the upright or stay wires with the main strands or bars, making the most substantial and flexible union mechanically possible. The fence may be forced out of alignment without bending the upright or stay wires, and when the pressure is removed they will spring back to their original position.

The tension curve takes up the expansion caused by heat, thereby preventing the fence from sagging, and also protects it from breakage, due to contraction caused by extreme cold or sudden temperature changes.

"American" Woven Wire Fencing has stays either 6 inches (152 m/m) or 12 inches (305 m/m) apart in all designs to specifications "A," "D," "E," "K," "L," "M" and "Park and Paddock," with the exceptions of Designs Nos. 635 to 845 to Specifications "A," "D" and "L," which are made only with stays 12 inches (305 m/m) apart. Specification "F" has stays 6 inches (152 m/m) apart. Specification "G" has stays either 12 inches (305 m/m) or 24 inches (610 m/m) apart.

Specification "A" signifies top bar No. 9 gauge, bottom bar No. 10 gauge, intermediate bars and stays No. 11 gauge wire, with the exception of Designs Nos. 832 and 726 which have top bars of No. 10 gauge wire. Specification "D" signifies all bars and stays of No. 9 gauge wire. Specification "E" signifies top and bottom bars No. 10 gauge, intermediate bars No. 12 gauge and stays No. 13 gauge wire. Specifications "K" and "M" have top and bottom bars No. 11 gauge, intermediate bars and stays No. 14 gauge wire. Specification "L" signifies top and bottom bars No. 10 gauge, intermediate bars and stays No. 12½ gauge wire. Specification "G" signifies all bars and stays of No. 7 gauge wire.

See list of styles and heights on page 69. For further particulars, see special catalogue of "American" Woven Wire Fencing, which will be furnished on request.

WOVEN WIRE FENCING.—*Continued*

“AMERICAN” WOVEN WIRE FENCING

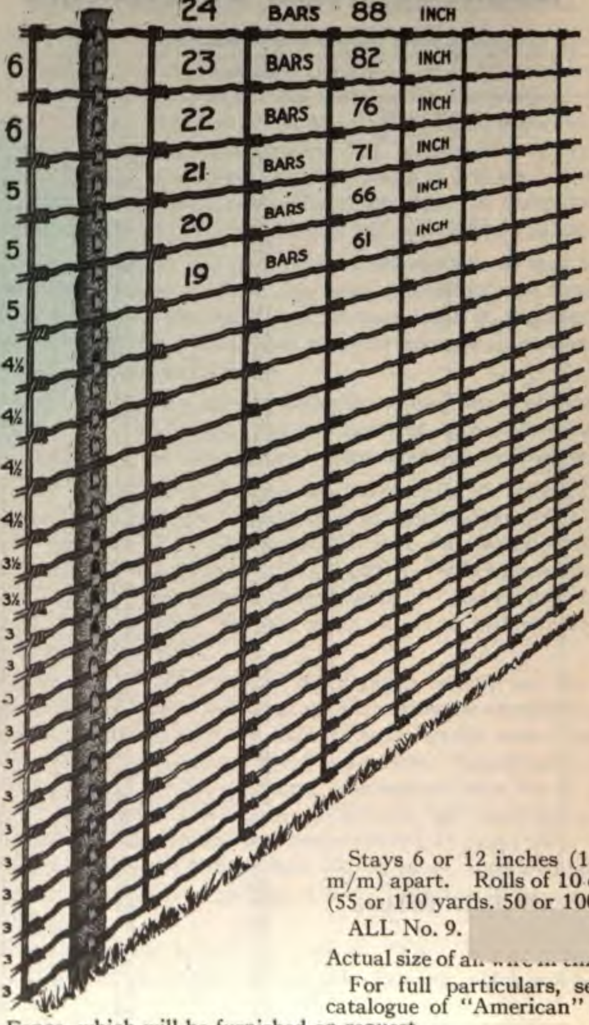
List of Styles and Heights

Style Number	Specifications	Number of Bars	Height	
			Inches	Meters
635	“A,” “D” or “L”	6	35	0.889
726	“ “ “ “	7	26	0.660
832	“ “ “ “	8	32	0.813
845	“ “ “ “	8	45	1.143
939	“ “ “ “	9	39	0.991
949	“ “ “ “	9	49	1.245
1047	“ “ “ “	10	47	1.194
1155	“ “ “ “	11	55	1.397
924	“E”	9	24	0.610
1028	“	10	28	0.711
1134	“	11	34	0.864
1240	“	12	40	1.016
1346	“	13	46	1.168
1452	“	14	52	1.321
1558	“	15	58	1.473
1324	“F”	13	24	0.610
1635	“	16	35	0.889
1843	“	18	43	1.092
1948	“	19	48	1.219
2053	“	20	53	1.346
2158	“	21	58	1.473
633	“G”	6	33	0.838
640	“	6	40	1.016
741	“	7	41	1.041
747	“	7	47	1.194
849	“	8	49	1.245
853	“	8	53	1.346
958	“	9	58	1.473
825	“K”	8	25	0.635
930	“	9	30	0.762
1035	“	10	35	0.889
1443	“	14	43	1.092
1548	“	15	48	1.219
726	“M”	7	26	0.660
832	“	8	32	0.813
939	“	9	39	0.991
1047	“	10	47	1.194
1961	Park and Paddock	19	61	1.549
2066	“ “ “	20	66	1.676
2171	“ “ “	21	71	1.803
2276	“ “ “	22	76	1.930
2382	“ “ “	23	82	2.083
2488	“ “ “	24	88	2.235

Woven Wire Fencing.—*Continued*

"AMERICAN" PARK AND PADDOCK FENCE

The highest and strongest woven steel fence made



Stays 6 or 12 inches (152 or 3 m/m) apart. Rolls of 10 or 20 r (55 or 110 yards. 50 or 100 meter

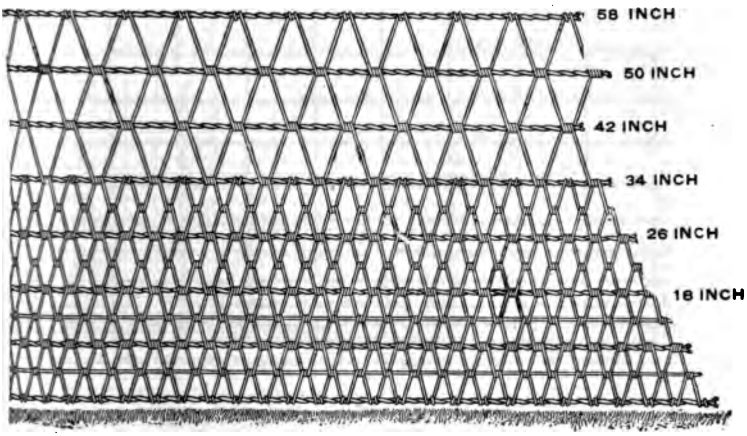
ALL No. 9.

Actual size of all wire in this fence

For full particulars, see spe catalogue of "American" Park a *Paddock* Fence, which will be furnished on request.

WOVEN WIRE FENCING.—*Continued*

"ELLWOOD" FENCE

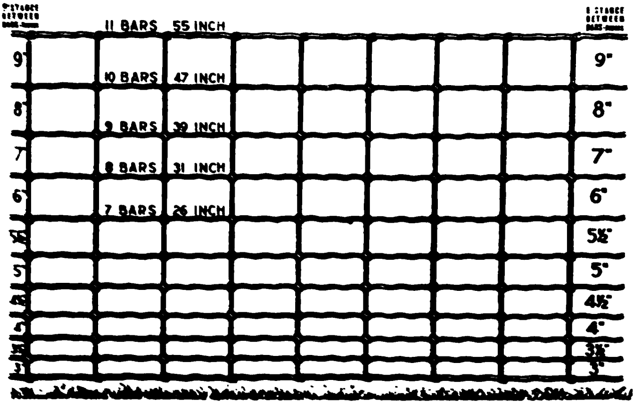


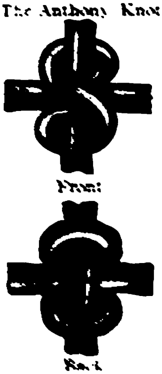
"Ellwood" Fence is of triangular mesh construction, made of heavily galvanized steel wire in a large variety of weights, styles and sizes, for fencing cattle, horses, hogs, sheep, poultry and small animals; also in several designs particularly suitable for enclosing lawns and private residences. It is made in heights varying from 18 to 58 inches (0.457 to 1.473 m), and is put up in rolls of 10, 20, 30 and 40 rods (55, 110, 165 and 220 yards; 50, 100, 150 and 200 meters).

For full particulars, see special "Ellwood" Fence Catalogue, which will be furnished on request.

WOVEN WIRE FENCING.—*Continued*

“ANTHONY” FENCE




The Anthony Knot

Front

Back

“Anthony” Fence is a “stiff-stay” fence, the upri
wires being tied to the longitudinals with the “
thony” Knot—the neatest and most positive cla
ever adopted. The grip of the Knot is such that
expansion or contraction by the greatest heat or c
has ever yet succeeded in loosening it.

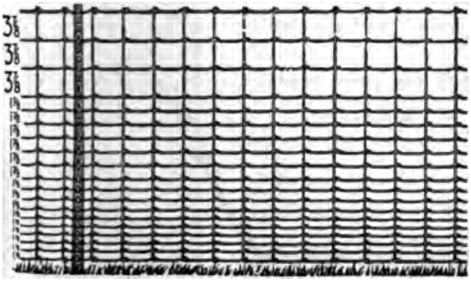
“Anthony” Fence is made to five different specifi
tions, in heights varying from 24 to 58 inches (0.
to 1.47 m), with stays 6 or 12 inches (152 or 305 m
apart.

Put up in rolls of 20, 30 and 40 rods (110, 165
220 yards (100, 150 and 200 meters). For furt
details, see special catalog of “Anthony” Fer
which will be furnished on request.

WOVEN WIRE FENCING.—*Continued*

"BANNER" POULTRY FENCE

"Banner" Poultry Fence is a close square mesh poultry fence of great strength and durability. It has all the advantages of the old style poultry fence with none of its disadvantages; being made of larger wires, it is stronger and more durable. Furthermore, it is a better appearing fence. The essential feature of a satisfactory poultry fence, closeness of mesh, is well taken care of in this fencing as the spacing between the six bottom line wires is only 1⅛ inches (28.6 m/m) and gradually increases to 3⅞ inches (98.4 m/m) at the top.



SPACING OF HORIZONTALS
Inches

STANDARD

Bottom six. . 1⅛
Next three. . 1⅜
Next six. . . . 1⅞
Balance. 3⅞

SPECIAL

Bottom six. . 1⅛
Next three. . 1⅜
Next six. . . . 1⅞
One each. . . . 2⅛, 2⅝, 3⅛, 3⅝
Balance. 3⅞

"BANNER" STANDARD POULTRY FENCE

Design Number	Height		Number of Bars
	Inches	Meters	
1012	12	.305	10
1318	18	.457	13
1624	24	.610	16
1936	36	.914	19
2248	48	1.22	22
2560	60	1.52	25
2872	72	1.83	28
3184	84	2.13	31

"BANNER" SPECIAL POULTRY FENCE

Design Number	Height		Number of Bars
	Inches	Meters	
1318	18	.457	13
1624	24	.610	16
2036	36	.914	20
2348	48	1.22	23
2660	60	1.52	26
2972	72	1.83	29
3284	84	2.13	32

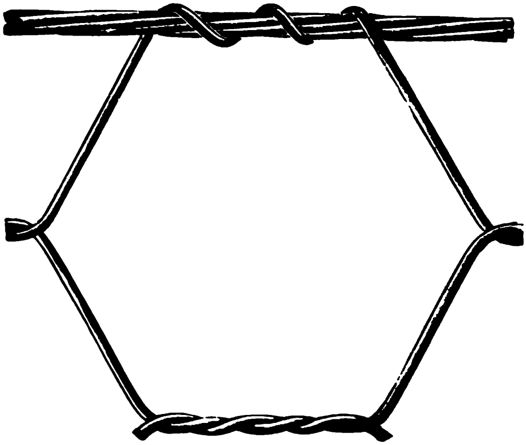
SPECIFICATIONS

	Standard	Special
Top and bottom horizontals.	15 Ga.	13 Ga.
Intermediate horizontals.	17 Ga.	15 Ga.
Upright.	17 Ga.	16 Ga.
Spacing of uprights.	4 inches	6 inches

Put up in rolls of 10 or 20 rods (55 or 110 yards, 50 or 100 meters).

AMERICAN GALVANIZED HEXAGON POULTRY NETTING

Galvanized Before or After Weaving



2-inch Mesh

Furnished with 4-inch, 2-inch, 1½-inch, 1¼-inch, 1-inch and ¾-inch mesh.

American Poultry Netting is made from specially selected steel and is fabricated and galvanized by the latest improved processes. It rolls out flat and stretches out even. The rolls are compact, thus saving space in shipping and storage, and are guaranteed to contain the full length of 150 lineal feet (45.72 meters).

American Poultry Netting is manufactured in the following standard widths: 12, 18, 24, 30, 36, 42, 48, 60 and 72 inches (0.305, 0.457, 0.610, 0.762, 0.914, 1.067, 1.219, 1.524 and 1.829 meters).

4-inch mesh is manufactured of Nos. 16, 17, 18, 19 and 20 gauge wire (A. S. & W. gauge); 2-inch mesh of Nos. 16, 18, 19 and 20 gauge wire; 1½-inch mesh of Nos. 18, 19 and 20 gauge wire; 1¼-inch mesh of Nos. 16, 17, 18, 19 and 20 gauge wire; 1-inch mesh of Nos. 19 and 20 gauge wire; and ¾-inch mesh of Nos. 19 and 20 gauge wire.

For full particulars, see Poultry Netting Catalogue, which will be furnished on request.

"AMERICAN" STEEL FENCE POSTS

"American" Steel Fence Posts are made of sheet steel, heavily coated with zinc, inside and outside, in the form of a tube, with tongues which may be bent upward or downward and by means of which any wire fence (whether of plain or barbed wire, or woven) may be firmly attached to the posts without the use of staples, knotting wires, or other devices. All exposed fittings are zinc coated.

These posts are light in weight (thereby reducing to a minimum the cost of transportation), but are very durable and amply strong enough for all fencing purposes. They have been tested, in actual use under the most trying conditions, for upwards of fifteen years and have been found thoroughly reliable and satisfactory in every way.

The Line Posts are made of No. 14½ gauge steel in lengths of 5, 6, 6½, 7, 7½, 8, 9, 10 and 11 feet (1.524, 1.829, 1.981, 2.134, 2.286, 2.438, 2.743, 3.048 and 3.353m).

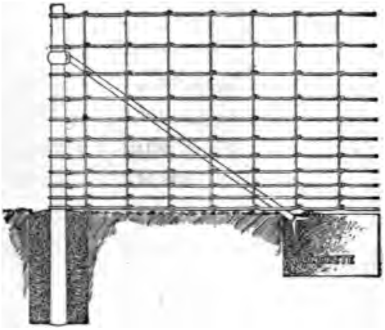
The End and Corner Posts are furnished complete with necessary fixtures, and are made of No. 10 gauge steel, in lengths of 7, 7½, 8, 9, 10 and 11 feet (2.134, 2.286, 2.438, 2.743, 3.048 and 3.353m), and of No. 12 gauge steel in lengths of 7 and 8 feet (2.134 and 2.438m).

Top Ornaments for End, Corner, and Line Posts furnished if desired.

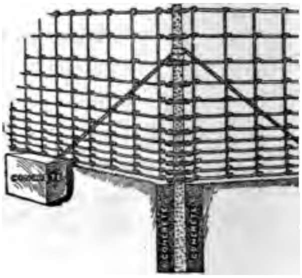
"AMERICAN" STEEL FENCE POSTS.—*Continued*

ANCHORING ENDS AND CORNER POSTS

It is not necessary to set the Line Posts in Concrete; they may b the ground by driving or by making a hole for the post and thoroughly ta The End and Corner Posts should, however, always be set in concr anchored as shown in the illustration below:



End Post



Corner Post

Each End Post is furnished with brace collar, brace and brace fo each Corner Post with brace collars, two braces and two brace feet, a plete, ready to set. These fixtures are included in the price of the po in shipping, are wired to the post.

For further particulars, see special catalogue of "American" Steel Posts, which will be furnished on request.

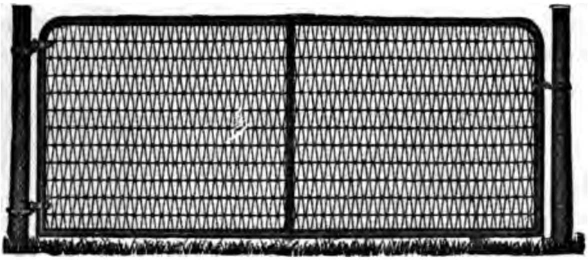
FENCE TOOLS, STRETCHERS, ETC.

We furnish a complete line of Stretchers, Splicers, and Fence To erecting Wire Fencing. For particulars, see special catalogues of Wire Fencing and Gates.

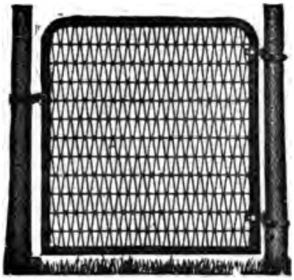
AMERICAN STEEL GATES

manufacture a number of types of steel gates all of which are made with nized steel pipe frames with a wire mesh filling. The wire filling is a nized steel fabric specially designed for the purpose and securely attached l sides to the pipe frame. All splices and ends are covered by the frame ng the contact surface smooth. These gates have great strength and ty being braced in all directions by the lateral and diagonal cross wires. mesh has a 2 inch (51 m/m) triangular opening.

pes of gates we manufacture are fully described and illustrated in special ogues of Woven Wire Fencing and Gates which will be furnished upon est. These types include Walk Gates with plain or ornamental tops, e Drive Gates with plain or ornamental tops, Double Drive Gates with or ornamental tops.



Single Drive Gate, used with American Steel Fence Posts
Made also with ornamental top



Walk Gate, used with American Steel Fence Posts
Made also with ornamental top

ELECTRICAL WIRES AND CABLES

Galvanized Telegraph and Telephone Wire, Extra Best Best (E. B. B.); Best Best (B. B.), and Steel. See page 79.

Copper Wires and Cables, insulated with rubber, paper, and varnished cambric, for lighting and power service.

Lead Encased Insulated Wires and Cables.

Cables armored with galvanized round steel wire and flat steel strip.

Rubber Insulated Copper Wires and Cables for interior wiring, our "Americore" Brand, 1918 (latest) National (U. S.) Electric Code Standard, in accordance with the rules and requirements of the National (U. S.) Board of Fire Underwriters.

Copper Wires and Cables insulated with our "Globe" Brand rubber, old N. E. Code Standard up to but not including 1911.

Copper Wires and Cables insulated with our "Amerite" rubber compound for station wiring, arc light and high voltage power transmission lines.

"Amerite" Signal Wires and Cables meet the specifications of the U. S Railway Signal Association.

Lamp Cord, cotton and silk covered, 3 grades, "Americore," 1918, (latest National (U. S.) Electric Code Standard; Grade A, up to but not including 1911 N. E. Code Standard; Grade C, regular "Commercial" Lamp Cord.

Reinforced Lamp Cord; Portable Cords; Electric Heater Cords.

Ignition Lighting and Starting Wires and Cables, for Automobiles, Motor Boats and Airplanes.

Weatherproof Insulated Copper Wires and Cables, 2 and 3 braids, our "Reliance" Brand, black finish.

Special Weatherproof and Slow Burning Wires and Cables, triple braid white finish.

Weatherproof Insulated Iron Wire, 2 and 3 braids, black finish.

Copper Magnet Wire, round, square and rectangular, insulated with cotton silk, asbestos and paper.

Enameled Magnet Wire. Office and Annunciator Wires.

See American Steel & Wire Company's special catalogue of Electrical Wires and Cables, which will be furnished on request.

GALVANIZED TELEGRAPH AND TELEPHONE WIRE

There are three standard grades of Galvanized Telegraph and Telephone Wire: Extra B. B. (E. B. B.), Best Best (B. B.) and Steel.

Extra Best Best is the highest in conductivity and therefore has the lowest electrical resistance. The physical properties are established at the highest practicable standards. This grade is used by the largest telegraph companies and for large railway systems. It is also used to a considerable extent for telephone lines.

Best Best is a stronger and tougher wire, and consequently is higher in electrical resistance. It is confined almost entirely to telephone service in the United States, but is used extensively for telegraph lines in other countries.

Steel Grade is generally considered suitable only for telephone service and chiefly for short lines. It is a comparatively high strength wire with a high resistance.

There is no difference in the spelter coating of the three grades; they are all galvanized to the highest commercial standards and all will stand the same immersion and wrapping tests. The diameters shown in the tables are standard and the weights are average, i. e., the mean between minimum and maximum weights due to diameter variations. It is impossible to draw wire to exact size and the diameters are subject to variations as follows:

Sizes 4 to 11 inclusive	.004 inch over or under
Sizes 12 to 14	.003 inch over or under

Weights and strengths vary in proportion to diameter variations.

PACKING

Sizes No. 10 B. W. G. and heavier will be furnished in coils consisting of two pieces only, pieces being joined by a standard twist joint and carefully soldered and galvanized; if preferred the joints will be electrically welded. Sizes lighter than No. 10 B. W. G. will be furnished in coils one-third of which may consist of two pieces with joints as described above.

Standard coils are 20½ inches and 22 inches inside diameter and as follows:

Size 4	¼ mile (about 402 meters)
Size 6	⅓ mile (about 536 meters)
Sizes 8 to 14 inclusive	½ mile (about 805 meters)

Each coil is bound in four places with galvanized steel wire with a tag attached showing size and grade. Each coil has a metal seal bearing the name of the American *Steel & Wire Company* as a guarantee of quality.

GALVANIZED TELEGRAPH AND TELEPHONE WIRE.—*Continued*

ELECTRICAL AND PHYSICAL STANDARDS OF GALVANIZED TELEGRAPH AND TELEPHONE WIRE COMMONLY ORDERED FOR EXPORT

B. W. G. No.	Diameter			*Approximate Weight			
	Inch	Mils	m/m	Per Mile, Pounds	Per 1000 Ft., Pounds	Per 1000 Mtr., Lbs.	Per 1000 Mtr., Kilos
4	.238	238	6.05	798	151	495.9	224.9
6	.203	203	5.16	581	110	361.0	163.8
8	.165	165	4.19	384	73	238.6	108.2
9	.148	148	3.76	309	59	192.0	87.1
10	.134	134	3.40	253	48	157.2	71.3
11	.120	120	3.05	203	38	126.1	57.2
12	.109	109	2.77	168	32	104.4	47.4
14	.083	83	2.11	97	18	60.3	27.4

*The approximate weight in pounds per mile, of other sizes may be obtained by squaring the diameter expressed in mils (1 mil equals .001 inch) and multiplying by .0141.

Grade	*Weight per Mile-Ohms in Pounds. Standard Temperature 68° Fahr., 20° C.	Breaking Strength Equals Weight per Mile Multiplied by Factors Given Below
Ex. B. B.	5000 to 5200	2.5 to 2.8
B. B.	5600 to 6000	2.8 to 3.0
Steel	6500 to 7000	3.0 to 3.5

*The resistance per mile in ohms of any size wire is obtained by dividing the weight per mile-ohm by the weight of the size in pounds per mile.

STANDARD PHYSICAL TESTS

B.W.G. No.	[1] Number of Twists in 6 Inch Length			[2] Per Cent. Elongation in 10 Inches			[3] Number of Bends		
	Ex.B.B.	B.B.	Steel	Ex.B.B.	B.B.	Steel	Ex.B.B.	B.B.	Steel
4	15	12	10	10	8	6	7	5	1
6	18	15	12	12	10	8	11	7	5
8	21	18	14	15	15	10	15	11	9
9	23	20	16	15	15	10	17	13	11
10	26	23	17	15	15	10	18	15	12
11	28	25	17	15	15	10	9	8	3
12	30	26	18	15	15	10	11	9	5
14	35	32	23	15	15	10	13	11	9

1. *Torsion*—The number of twists a test piece of 6 inches free length between grips will stand before splitting or breaking. The piece is gripped in two vises, one of which revolves at a speed not exceeding one revolution per second. The twists are counted by means of a line drawn in ink along the test piece. The full number of twists must be visible between the grips in the form of a spiral, fractions are not considered.
2. *Elongation*—The percentum elongation in a test piece 10 inches free length between grips.
3. *Bends*—The number of bends a test piece will stand before breaking. The piece may be any length convenient for testing. The bending test will be made as follows:

GALVANIZED TELEGRAPH AND TELEPHONE WIRE.—*Continued*

The piece is gripped between the jaws of a vise, the jaws rounded to a radius set forth further on. When gripped the piece will be perpendicular to the jaws. It is then bent down to horizontal, i. e. through 90 degrees, this bend not being counted. The piece is then given a full bend, through 180 degrees to horizontal, this bend counting one, and so on. The jaws of the vise will be rounded to a radius of,

For sizes 4 to 10 inclusive.....0.394 inch
For sizes 11 to 14 inclusive.....0.197 inch

SPECIFICATIONS FOR GALVANIZING OF TELEGRAPH AND TELEPHONE WIRE:

The wire shall be well galvanized in accordance with the following specifications:

The galvanizing shall consist of a continuous coating of pure zinc of practically uniform thickness, and so applied that it adheres firmly to the surface of the wire. No. 12 B. W. G. and coarser sizes of wire shall be capable of withstanding the following test:

TESTING SOLUTION: A standard solution shall be prepared by selecting crystals of commercial sulphate of copper which are clean and have a clear blue color, and dissolving them in lukewarm water. The solution shall be allowed to stand for at least twelve hours with occasional stirring. Some undissolved crystals should remain at the bottom of the vessel at the end of this time. The solution shall be neutralized by the addition of an excess of cupric oxide. The neutralized solution shall then be filtered before using. (See note below).

METHOD OF TESTING: Samples of wire previously cleaned with gasoline or benzine shall be immersed, to a distance of at least four inches, in a glass vessel containing not less than one pint of the standard solution and allowed to remain for one minute. They shall then be removed, washed in clean water and wiped dry with soft cotton cloth or waste. This process shall be repeated three times, making four immersions in all.

NOTE.—A saturated solution of sulphate of copper thus prepared should have a specific gravity of 1.186 at a temperature of 65 degrees F. In case of No. 14 B. W. G. wire, the fourth immersion shall be of one-half minute duration instead of one minute.

The temperature of the solution during the test shall not be above 60 degrees F. or below 56 degrees F. (15.6 degrees C.—13.3 degrees C.).

Not more than seven samples of wire shall be immersed at one time, and no solution shall be used for more than one set of four immersions.

If a bright copper deposit appears on the steel after the fourth immersion, thus indicating that the wire is exposed, the galvanizing of the lot of wire represented by the samples shall be considered faulty. Copper deposits on zinc or within one inch of the cut end shall not be considered cause for rejection.

The galvanized wire shall stand wrapping around a cylindrical bar with a diameter twelve times the diameter of the size under test without causing the zinc to peel or flake off.

WIRE ROPES AND STRANDS

We furnish Wire Rope, Strands and Cords for all purposes, made of American Iron, Crucible Cast Steel, Extra Strong Crucible Cast Steel and Plow Steel; also Improved Plow Steel, our "Monitor" Brand.

Below we give a list of the usual varieties and sizes manufactured, and on the following pages a description of the various types of construction, with particulars of sizes, weights, approximate breaking stresses, etc., of some of the principal types of Wire Rope usually furnished. For further particulars, see special Wire Rope Catalogue, furnished on request.

Transmission, Haulage and Standing Rope, $\frac{9}{32}$ to $1\frac{1}{2}$-in. diameter.
Flattened Strand Haulage and Transmission Rope, $\frac{3}{8}$ to $1\frac{1}{2}$-in. diameter.
Standard Hoisting Rope, $\frac{1}{4}$ to $2\frac{3}{4}$-in. diameter.
Extra Flexible Hoisting Rope, $\frac{1}{4}$ to $1\frac{1}{2}$-in. diameter.
Special Flexible Hoisting Rope, $\frac{3}{8}$ to $2\frac{3}{4}$-in. diameter.
Marlin Clad Wire Rope.
Steel Clad Hoisting Rope.
Flattened Strand Hoisting Rope, $\frac{3}{8}$ to $2\frac{1}{4}$-in. diameter.
Non-Spinning Hoisting Rope, $\frac{3}{8}$ to $1\frac{3}{4}$-in. diameter.
Galvanized Ship's Rigging and Guy Ropes, $\frac{3}{16}$ to $1\frac{3}{4}$-in. diameter.
Galvanized Yacht Rigging, $\frac{5}{16}$ to $1\frac{1}{4}$-in. diameter.
Galvanized Running Rope, $\frac{5}{16}$ to $1\frac{1}{16}$-in. diameter.
Galvanized Steel Hawsers and Mooring Lines, $\frac{3}{4}$ to $2\frac{1}{16}$-in. diameter.
Galvanized Deep Sea Towing Hawsers, $\frac{3}{4}$ to $2\frac{3}{8}$-in. diameter.
Galvanized Cables for Suspension Bridges, $1\frac{1}{4}$ to $2\frac{3}{4}$-in. diameter.
Galvanized Mast Arm Ropes, $\frac{1}{4}$ to $\frac{1}{2}$-in. diameter.
Tiller or Hand Ropes, $\frac{1}{4}$ to 1-in. diameter.
Aeroplane Strand and Cord, $\frac{1}{32}$ to $\frac{5}{32}$-in. diameter.
Flexible Aeroplane and Motor Boat Cord, $\frac{3}{32}$ to $\frac{3}{16}$-in. diameter.
Sash Cord, $\frac{1}{16}$ to $\frac{1}{4}$-in. diameter.
Galvanized Steel Strand, 7-ply, $\frac{5}{32}$ to $\frac{5}{8}$-in. diameter.
Track Strand for Aerial Tramways, $\frac{5}{8}$ to $2\frac{1}{2}$-in. diameter.
Locomotive Switching Ropes, fitted complete.
Ballast-Unloader Cables, fitted complete.
Extra Flexible Pulling-in Cables.
Drilling and Sand Lines for Oil Wells.

Flat Wire Ropes, $\frac{3}{8}$ and $\frac{1}{2}$-in. thick, by 2 to 7-in. wide; wider and thicker ropes to order.

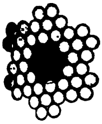
Special Iron, Steel, Crucible Cast Steel, Plow Steel or Special Steel Ropes, to order, galvanized, bright, coppered, tinned.

Wire Rope Fittings of all kinds and sizes, see Wire Rope Catalogue for particulars.

Wire Ropes and Strands.—*Continued*

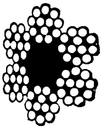
TYPES OF WIRE ROPE

The forms of construction of the standard types of wire rope are illustrated elow:

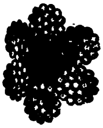


Haulage, Transmission and Standing Rope Construction

Composed of 6 strands, 7 wires each. Used principally for mine haulage, transmission of power, ships' rigging, guys and similar purposes. Also used for suspension bridges, in which case a wire center is substituted for the regular hemp center.



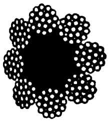
Large sizes of ships' rigging, guy ropes, etc., are sometimes constructed of 6 strands, 12 wires each.



Standard Hoisting Rope Construction

Composed of 6 strands, 19 wires each. This rope combines flexibility, strength and durability. It is commonly used on elevators, mine hoists, cargo and coal hoists, derricks, conveyors, cable railways, and the like.

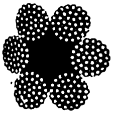
Extra Flexible Hoisting Rope Construction



Composed of 8 strands, 19 wires each.

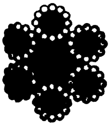
Used on derricks, coal handling machinery, pile drivers, steam shovels and for tubing and casing lines in oil districts.

Extra Flexible Monitor Plow Steel Hoisting Rope is used where the greatest tensile strength in an 8 strand rope is necessary for a given size of rope to pass over small drums or sheaves.



Special Flexible Hoisting Rope Construction

Composed of 6 strands, 37 wires each. This rope possesses extreme flexibility and strength. It is used principally on large cranes, derricks and dredges. Our deep sea towing hawsers are also of this construction.



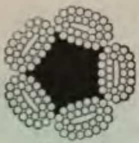
Running Rigging Construction

Composed of 6 strands, 12 wires, each strand having a hemp center. Rope of this character is very flexible and is used principally for running rigging on ships.

WIRE ROPES AND STRANDS.—*Continued*

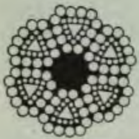
TYPES OF WIRE ROPE.—*Continued*

FLATTENED STRAND ROPE CONSTRUCTION



Type A

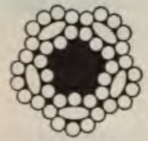
Flattened Strand Rope is constructed in four styles designated as *types A, B, C and D*. These peculiar forms of construction produce a combination of flexibility with increased wearing surfaces, which makes them particularly efficient in certain service. Furthermore, the smooth wearing surfaces do not score or cut the sheaves and drums on which they operate.



Type B

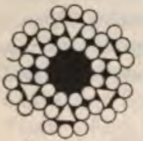
Flattened Strand Iron Hoisting Rope, *type A*, is used principally in sizes ⅝-inch to 1-inch diameter for elevator hoisting.

Flattened Strand Crucible Cast Steel, Extra Strong Crucible Cast Steel, and Monitor Plow Steel Hoisting Ropes, *type A*, five strands around a hemp center, sizes ⅝-inch and smaller, are suited to derricks and cold hoisting towers. *Type A*, however, requires great care and pains to splice successfully.



Type C

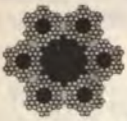
Flattened Strand Crucible Cast Steel, Extra Strong Crucible Cast Steel, and Monitor Plow Steel Hoisting Ropes, *type B*, six strands around a hemp center, sizes ¾-inch and larger, are generally employed for heavy derricks, dredges, coal and ore hoists, haulage systems, logging, ballast unloaders, etc.



Type D

Flattened Strand Crucible Cast Steel, Extra Strong Crucible Cast Steel, and Monitor Plow Steel Haulage Ropes, *type C*, five strands around a hemp center, and *type D*, six strands around a hemp center, are sometimes used on haulage systems where the abrasion is unusually severe and the sheaves and drums are of ample size.

TILLER ROPE CONSTRUCTION



Composed of six strands, each strand being itself a complete rope of six strands, 7 wires each, around a hemp center. Thus there are in all 252 wires, with six small and one large hemp core. This is the most flexible form of wire rope manufactured. Used chiefly for elevator hand rope and steering lines on vessels.

Wire Ropes and Strands.—*Continued*

HOW TO ORDER WIRE ROPE

Use the exact terms of description given in catalogue for each rope, stating quality, number of strands, wires in the strand, and whether hemp core, or wire center; size, in diameter or circumference; and length.

In ordering rope fitted with thimbles, sockets, or hooks, state the length from pull of thimble, socket or hook, to end of rope. If there are fittings in both ends, state length of rope from pull to pull of fittings.

When doubtful as to the material to be used, the conditions under which the rope is to operate should be given, or sample submitted, in order that the proper quality and construction may be furnished.

When possible, a rough sketch showing size and position of sheaves, and maximum load in pounds upon the rope, should be sent with inquiry or order.

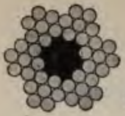
When ordering rope for elevators, state whether Hoisting, Counterweight or Hand Rope is wanted.

STANDARD BREAKING STRESSES

The approximate breaking stresses shown in the following tables are the standard strengths adopted May 1, 1910, by the wire rope manufacturers of the United States of America. They are based upon the average results obtained by actual tests applied to a large number of specimens. In former editions of this catalogue, the approximate breaking stresses shown in the wire rope tables were based upon the aggregate strengths of the wires forming the rope, disregarding the loss of strength resulting from the process of twisting which was the usual method of calculation at that time. The real strength of the rope has in no case been diminished, but the new method of calculation has been adopted with the result that the figures now shown are more nearly correct and reliable than those given in former editions.

SAFE WORKING LOADS

The working loads for hoisting and haulage ropes should not exceed one-fifth the ultimate or breaking stress of the rope. The working load for standing or guy rope, however, may be somewhat exceeded. For shafts and elevators, where human life is at stake, the working load should be one-seventh or one-tenth the strength of the rope.



CRUCIBLE CAST STEEL TRANSMISSION HAULAGE OR STANDING ROPE

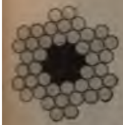
Seven Wires to the Strand. Six Strands—One Hemp Core

Diameter		Approximate Circumference		Approximate Weight		Approximate Breaking Stress		Diameter of Drum or Sheave Advised	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Feet	Meters
1½	38	4¾	121	3.55	5.28	63	57150	11	3.35
1⅜	35	4¼	108	3.00	4.46	53	48100	10	3.05
1¼	32	4	102	2.45	3.65	46	41750	9	2.74
1⅛	29	3½	89	2.00	2.98	37	33550	8	2.44
1	25	3	76	1.58	2.35	31	28100	7	2.13
⅞	22	2¾	70	1.20	1.79	24	21750	6	1.83
¾	19	2¼	57	0.89	1.32	18.6	16850	5	1.52
11/16	17	2⅛	54	0.75	1.12	15.4	14000	4¾	1.45
⅝	16	2	51	0.62	0.92	13	11800	4½	1.37
9/16	14	1¾	44	0.50	0.74	10	9100	4	1.22
½	13	1½	38	0.39	0.58	7.7	7000	3½	1.07
7/16	11	1¼	32	0.30	0.45	5.5	5000	3	0.91
⅜	9.5	1⅛	29	0.22	0.33	4.6	4150	2¾	0.84
5/16	8	1	25	0.15	0.22	3.5	3200	2¼	0.69
9/32	7	⅞	22	0.125	0.19	2.5	2250	1¾	0.53

This rope is made of a high quality of crucible cast steel and is much stiffe than hoisting rope. It is particularly adapted to use in haulage systems, an on inclined planes where subjected to considerable abrasive wear. It also frequently used as a haulage rope on aerial wire rope tramways. Fo sand lines and cleaning out cables for deep oil well drilling, this rope is use almost exclusively.

For proper working loads, see page 85.

Also made in IRON and EXTRA STRONG CRUCIBLE CAST STEE qualities; for particulars, see special Wire Rope catalogue.



PLOW STEEL TRANSMISSION, HAULAGE OR STANDING ROPE

SEVEN WIRES TO THE STRAND. SIX STRANDS—ONE HEMP CORE

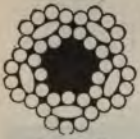
Diameter		Approximate Circumference		Approximate Weight		Approximate Breaking Stress		Diameter of Drum or Sheave Advised	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Feet	Meters
$1\frac{1}{2}$	38	$4\frac{3}{4}$	121	3.55	5.28	82	74400	11	3.35
$1\frac{3}{8}$	35	$4\frac{1}{4}$	108	3.00	4.46	72	65300	10	3.05
$1\frac{1}{4}$	32	4	102	2.45	3.65	60	54450	9	2.74
$1\frac{1}{8}$	29	$3\frac{1}{2}$	89	2.00	2.98	47	42650	8	2.44
1	25	3	76	1.58	2.35	38	34450	7	2.13
$\frac{7}{8}$	22	$2\frac{3}{4}$	70	1.20	1.79	31	28100	6	1.83
$\frac{3}{4}$	19	$2\frac{1}{4}$	57	0.89	1.32	23	20850	5	1.52
$\frac{11}{16}$	17	$2\frac{1}{8}$	54	0.75	1.12	18	16350	$4\frac{3}{4}$	1.45
$\frac{5}{8}$	16	2	51	0.62	0.92	16	14500	$4\frac{1}{2}$	1.37
$\frac{9}{16}$	14	$1\frac{3}{4}$	44	0.50	0.74	12	10900	4	1.22
$\frac{1}{2}$	13	$1\frac{1}{2}$	38	0.39	0.58	10	9050	$3\frac{1}{2}$	1.07
$\frac{7}{16}$	11	$1\frac{1}{4}$	32	0.30	0.45	7	6350	3	0.91
$\frac{3}{8}$	9.5	$1\frac{1}{8}$	29	0.22	0.33	5.9	5350	$2\frac{3}{4}$	0.84
$\frac{5}{16}$	8	1	25	0.15	0.22	4.4	4000	$2\frac{1}{4}$	0.69
$\frac{9}{32}$	7	$\frac{7}{8}$	22	0.125	0.19	3.4	3100	$1\frac{3}{4}$	0.53

This rope is used principally for haulage and transmission systems. When galvanized, it serves admirably for standing rigging on racing yachts and large sailing ships, where great strength and light weight are required.

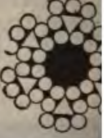
For proper working loads, see page 85.

Also made in MONITOR PLOW STEEL quality; for particulars, see special Wire Rope catalogue.

FLATTENED STRAND CRUCIBLE CAST STEEL HAULAGE AND TRANSMISSION ROPE



Type C



Type D

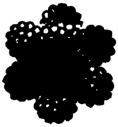
Type C—5 strands, 9 wires to the strand, one hemp core.

Type D—6 strands, 8 wires to the strand, one hemp core.

Diameter		Type C				Type D				Diameter Drum o Sheave Advised	
		Approximate Weight		Approximate Breaking Stress		Approximate Weight		Approximate Breaking Stress			
Inches	m/m	Per Foot, Lbs.	Per Meter, Kilos	Tons of 2000 Lbs.	Kilos	Per Foot, Lbs.	Per Meter, Kilos	Tons of 2000 Lbs.	Kilos	Feet	Me
1½	38	3.65	5.43	63	57150	4.00	5.95	68	61700	8½	2
1⅜	35	3.10	4.61	53	48100	3.45	5.13	57	51700	8	2
1¼	32	2.55	3.79	46	41750	2.80	4.17	50	45350	7¼	2
1⅛	29	2.05	3.05	37	33550	2.30	3.42	40	36300	6¼	1
1	25	1.65	2.46	31	28100	1.80	2.68	34	30850	5¾	1
⅞	22	1.24	1.85	24	21750	1.38	2.05	26	23600	5	1
¾	19	0.92	1.37	18.6	16850	1.00	1.49	20	18150	4½	1
⅝	16	0.64	0.95	13	11800	0.72	1.07	14	12700	3½	1
½	13	0.40	0.60	7.7	7000	0.45	0.67	8.3	7550	2½	0
⅜	9.5	0.23	0.34	4.6	4150	0.25	0.37	5	4550	2	0

For proper working loads see page 85.

Also made in IRON, EXTRA STRONG CRUCIBLE CAST STEEL, MONITOR PLOW STEEL qualities; for particulars, see special Wire R catalogue.



IRON HOISTING ROPE

NINETEEN WIRES TO THE STRAND. SIX STRANDS—ONE HEMP CORE

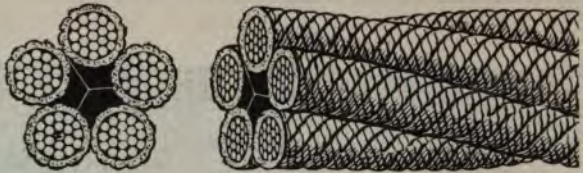
Diameter		Approximate Circumference		Approximate Weight		Approximate Breaking Stress		Diameter of Drum or Sheave Advised	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Feet	Meters
2 3/4	70	8 5/8	219	11.95	17.78	111	100700	17	5.18
2 1/2	64	7 7/8	200	9.85	14.66	92	83450	15	4.57
2 1/4	57	7 1/8	181	8.00	11.90	72	65300	14	4.27
2	51	6 1/4	159	6.30	9.37	55	49900	12	3.66
1 7/8	48	5 3/4	146	5.55	8.26	50	45350	12	3.66
1 3/4	44	5 1/2	140	4.85	7.22	44	39900	11	3.35
1 5/8	41	5	127	4.15	6.18	38	34500	10	3.05
1 1/2	38	4 3/4	121	3.55	5.28	33	29950	9	2.74
1 3/8	35	4 1/4	108	3.00	4.47	28	25400	8.5	2.59
1 1/4	32	4	102	2.45	3.65	22.8	20700	7.5	2.29
1 1/8	29	3 1/2	89	2.00	2.98	18.6	16850	7	2.13
1	25	3	76	1.58	2.35	14.5	13150	6	1.83
7/8	22	2 3/4	70	1.20	1.79	11.8	10700	5.5	1.68
3/4	19	2 1/4	57	0.89	1.32	8.5	7700	4.5	1.37
5/8	16	2	51	0.62	0.92	6	5450	4	1.22
9/16	14	1 3/4	44	0.50	0.74	4.7	4250	3.5	1.07
1/2	13	1 1/2	38	0.39	0.58	3.9	3550	3	0.91
7/16	11	1 1/4	32	0.30	0.45	2.9	2650	2.75	0.84
3/8	9.5	1 1/8	29	0.22	0.33	2.4	2200	2.25	0.69
5/16	8	1	25	0.15	0.22	1.5	1350	2	0.61
1/4	6	3/4	19	0.10	0.15	1.1	1000	1.50	0.46

For proper working loads, see page 85.

The wires in this rope being of the best quality of iron, are soft, tough and pliable. This rope is especially adapted for elevator service and may also be used for general hoisting and running purposes where high tensile strength and resistance to abrasion are not essential. It is also used for transmission of power where pulleys are smaller than standard.

Furnished with wire core at an advance in price.

MARLIN CLAD WIRE ROPE



Marlin Clad Wire Rope is constructed as follows: ·

Each strand is served with tarred marlin; strands are twisted around a core. The usual number of wires in a strand is seven or nineteen and nu of strands four, five or six.

This rope is particularly adapted for ships' rigging, Cargo Hoist, I transmission, etc. Marlin Clad Rope is considerably stronger than M rope of the same diameter. For instance 1-inch diameter Marlin Clad steel rope has a strength of 31,000 pounds, and the strength of 1-inch dia Manila rope is 7,500 pounds. Marlin Clad Rope weighs approximately less than Manila rope of the same strength.

CRUCIBLE CAST STEEL MARLIN CLAD WIRE RO

Nineteen Wires to the Strand. Five Strands—One Hemp Co

Diameter Before Serving		Approximate Diameter After Serving with Marlin		Approximate Circumference After Serving with Marlin		Approximate Weight		Approximate Breaking Stress		Minin Diame Drun Shea
Inches	m/m	Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Feet
1⅜	35	1¾	44	5½	140	3.06	4.55	56	50800	5½
1¼	32	1⅝	41	5⅛	130	2.52	3.75	47	42650	5
1⅛	29	1½	38	4¾	121	2.07	3.08	38	34450	4½
1	25	1⅜	35	4 5/16	110	1.66	2.47	30	27200	4
⅞	22	1¼	32	3⅞	98	1.29	1.92	23	20850	3½
¾	19	1⅛	29	3½	89	1.12	1.67	17.5	15900	3
⅝	16	1	25	3⅛	79	0.80	1.19	12.5	11350	2¼
½	13	¾	19	2⅜	60	0.49	0.73	8.4	7600	1½
⅜	9.5	⅝	16	2	51	0.36	0.54	4.8	4350	1
¼	6	½	13	1½	38	0.21	0.31	2.2	2000	½

For proper working loads, see page 85.

MARLIN CLAD WIRE ROPE.—*Continued*

EXTRA STRONG CRUCIBLE CAST STEEL MARLIN CLAD WIRE ROPE

NINETEEN WIRES TO THE STRAND. FIVE STRANDS—ONE HEMP CORE

Diameter Before Serving		Approximate Diameter After Serving with Marlin		Approximate Circumference After Serving with Marlin		Approximate Weight		Approximate Breaking Stress		Minimum Diameter of Drum or Sheave	
Inches	m/m	Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Feet	Meters
1⅜	35	1¾	44	5½	140	3.06	4.55	64	58050	5½	1.68
1¼	32	1⅝	41	5⅛	130	2.52	3.75	53	48100	5	1.52
1⅛	29	1½	38	4¾	121	2.07	3.08	43	39000	4½	1.37
1	25	1⅜	35	4 5/16	110	1.66	2.47	34	30850	4	1.22
⅞	22	1¼	32	3⅞	98	1.29	1.92	26	23600	3½	1.07
¾	19	1⅛	29	3½	89	1.12	1.67	20.2	18300	3	0.91
⅝	16	1	25	3⅛	79	0.80	1.19	14.0	12700	2¼	0.69
½	13	¾	19	2⅜	60	0.49	0.73	9.2	8350	1½	0.46
⅜	9.5	⅝	16	2	51	0.36	0.54	5.30	4800	1	0.30
¼	6	½	13	1½	38	0.21	0.31	2.43	2200	½	0.15

For proper working loads, see page 85.

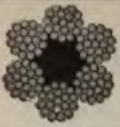
PLOW STEEL MARLIN CLAD WIRE ROPE

NINETEEN WIRES TO THE STRAND. FIVE STRANDS—ONE HEMP CORE

Diameter Before Serving		Approximate Diameter After Serving with Marlin		Approximate Circumference After Serving with Marlin		Approximate Weight		Approximate Breaking Stress		Minimum Diameter of Drum or Sheave	
Inches	m/m	Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Feet	Meters
1⅜	35	1¾	44	5½	140	3.06	4.55	72	65300	5¼	1.60
1¼	32	1⅝	41	5⅛	130	2.52	3.75	58	52600	5	1.52
1⅛	29	1½	38	4¾	121	2.07	3.08	47	42650	4½	1.37
1	25	1⅜	35	4 5/16	110	1.66	2.47	38	34450	4¼	1.30
⅞	22	1¼	32	3⅞	98	1.29	1.92	29	26300	3¾	1.14
¾	19	1⅛	29	3½	89	1.12	1.67	23	20850	3½	1.07
⅝	16	1	25	3⅛	79	0.80	1.19	15.5	14050	3	0.91
½	13	¾	19	2⅜	60	0.49	0.73	10.0	9050	2	0.61
⅜	9.5	⅝	16	2	51	0.36	0.54	5.75	5200	1	0.30
¼	6	½	13	1½	38	0.21	0.31	2.65	2400	⅔	0.20

For proper *working loads, see page 85.*

Other constructions of Marlin Clad Rope made to order.



CRUCIBLE CAST STEEL HOISTING ROPE

NINETEEN WIRES TO THE STRAND. SIX STRANDS—ONE HEMP CORE

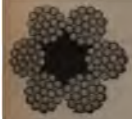
Diameter		Approximate Circumference		Approximate Weight		Approximate Breaking Stress		Diameter of Drum or Sheave Advised	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Feet	Meters
2¾	70	8⅝	219	11.95	17.78	211	191400	11	3.35
2½	64	7⅞	200	9.85	14.66	170	154200	10	3.05
2¼	57	7⅛	181	8.00	11.90	133	120650	9	2.74
2	51	6¼	159	6.30	9.38	106	96150	8	2.44
1⅞	48	5¾	146	5.55	8.26	96	87100	8	2.44
1¾	44	5½	140	4.85	7.22	85	77100	7	2.13
1⅝	41	5	127	4.15	6.18	72	65300	6.5	1.98
1½	38	4¾	121	3.55	5.28	64	58050	6	1.83
1⅜	35	4¼	108	3.00	4.47	56	50800	5.5	1.68
1¼	32	4	102	2.45	3.65	47	42650	5	1.52
1⅛	29	3½	89	2.00	2.98	38	34450	4.5	1.37
1	25	3	76	1.58	2.35	30	27200	4	1.22
⅞	22	2¾	70	1.20	1.79	23	20850	3.5	1.07
¾	19	2¼	57	0.89	1.32	17.5	15900	3	0.91
⅝	16	2	51	0.62	0.92	12.5	11350	2.5	0.76
9/16	14	1¾	44	0.50	0.74	10	9050	2.25	0.69
½	13	1½	38	0.39	0.58	8.4	7600	2	0.61
7/16	11	1¼	32	0.30	0.45	6.5	5900	1.75	0.53
⅜	9.5	1⅛	29	0.22	0.33	4.8	4350	1.50	0.46
5/16	8	1	25	0.15	0.22	3.1	2800	1.25	0.38
¼	6	¾	19	0.10	0.15	2.2	2000	1	0.30

This rope is applicable to a great variety of uses. It is particularly adapted to service in mines, for logging, on elevators, derricks, hay presses, dredges and inclined planes, cableways, cargo and coal hoists, conveyors, skip hoists and ballast unloaders.

The wire used in the construction of this rope is of the best quality of crucible cast steel, possessing double the strength of iron in the same diameter. Furnished with wire core at an advance in price.

For proper working loads, see page 85.

Also made in EXTRA STRONG CRUCIBLE CAST STEEL quality. For particulars, see special Wire Rope catalogue.



PLOW STEEL HOISTING ROPE

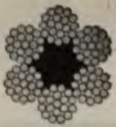
NINETEEN WIRES TO THE STRAND. SIX STRANDS—ONE HEMP CORE

Diameter		Approximate Circumference		Approximate Weight		Approximate Breaking Stress		Diameter of Drum or Sheave Advised	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Feet	Meters
2¾	70	8⅝	219	11.95	17.78	275	249500	11	3.35
2½	64	7⅞	200	9.85	14.66	229	207700	10	3.05
2¼	57	7⅛	181	8.00	11.90	186	186700	9	2.74
2	51	6¼	159	6.30	9.37	140	127000	8	2.44
1⅞	48	5¾	146	5.55	8.26	127	115200	8	2.44
1¾	44	5½	140	4.85	7.22	112	101600	7	2.13
1⅝	41	5	127	4.15	6.18	94	85300	6.5	1.98
1½	38	4¾	121	3.55	5.28	82	74400	6	1.83
1⅜	35	4¼	108	3.00	4.47	72	65300	5.5	1.68
1¼	32	4	102	2.45	3.65	58	52600	5	1.52
1⅛	29	3½	89	2.00	2.98	47	42650	4.5	1.37
1	25	3	76	1.58	2.35	38	34450	4	1.22
⅞	22	2¾	70	1.20	1.79	29	26300	3.5	1.07
¾	19	2¼	57	0.89	1.32	23	20850	3	0.91
⅝	16	2	51	0.62	0.92	15.5	14050	2.5	0.76
9/16	14	1¾	44	0.50	0.74	12.3	11150	2.25	0.69
½	13	1½	38	0.39	0.58	10	9050	2	0.61
7/16	11	1¼	32	0.30	0.45	8	7250	1.75	0.53
⅜	9.5	1⅛	29	0.22	0.33	5.75	5200	1.50	0.46
5/16	8	1	25	0.15	0.22	3.8	3450	1.25	0.38
¼	6	¾	19	0.10	0.15	2.65	2400	1	0.30

This rope is used for heavy hoisting in mines, on derricks, dredges, inclined planes, cableways, for logging, and for ammunition hoists. In deep mining shafts and on long inclines where the weight of the rope forms a large part of the load, plow steel rope is the most economical.

For cranes, dredges or work requiring extreme flexibility, a special plow steel hoisting rope of the six strand, 37 wires per strand construction, may be substituted for the regular form at an advance in price.

For proper working loads, see page 85.



MONITOR PLOW STEEL HOISTING ROPE

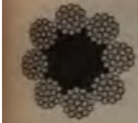
NINETEEN WIRES TO THE STRAND. SIX STRANDS—ONE HEMP CORE

Diameter		Approximate Circumference		Approximate Weight		Approximate Breaking Stress		Diameter of Drum or Sheave Advised	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Feet	Meters
2¾	70	8⅝	219	11.95	17.78	315	285750	11	3.35
2½	64	7⅞	200	9.85	14.66	263	238600	10	3.05
2¼	57	7⅛	181	8	11.90	210	190500	9	2.74
2	51	6¼	159	6.30	9.38	166	150600	8	2.44
1⅞	48	5¾	146	5.55	8.26	150	136100	8	2.44
1¾	44	5½	140	4.85	7.22	133	120650	7	2.13
1⅝	41	5	127	4.15	6.18	110	99800	6½	1.98
1½	38	4¾	121	3.55	5.28	98	88900	6	1.83
1⅜	35	4¼	108	3	4.46	84	76200	5½	1.68
1¼	32	4	102	2.45	3.65	69	62600	5	1.52
1⅛	29	3½	89	2	2.98	56	50800	4½	1.37
1	25	3	76	1.58	2.35	45	40800	4	1.22
⅞	22	2¾	70	1.20	1.79	35	31750	3½	1.07
¾	19	2¼	57	0.89	1.32	26.3	23850	3	0.91
⅝	16	2	51	0.62	0.92	19	17250	2½	0.76
9/16	14	1¾	44	0.50	0.74	14.5	13150	2¼	0.69
½	13	1½	38	0.39	0.58	12.1	11000	2	0.61
7/16	11	1¼	32	0.30	0.45	9.4	8550	1¾	0.53
⅜	9.5	1⅛	29	0.22	0.33	6.75	6100	1½	0.46
5/16	8	1	25	0.15	0.22	4.50	4100	1¼	0.38
¼	6	¾	19	0.10	0.15	3.15	2850	1	0.30

This grade of rope is the strongest and most efficient produced. For service requiring great strength, it is unsurpassed. It is particularly suitable fo use on derricks, skidders, dredges and stump-pullers.

For proper working loads, see page 85.

MONITOR PLOW STEEL haulage rope, 6 strands, 7 wires each, hem center, and other forms of construction furnished, if desired.



EXTRA FLEXIBLE CRUCIBLE CAST STEEL HOISTING ROPE

NINETEEN WIRES TO THE STRAND. EIGHT STRANDS—ONE HEMP CENTER

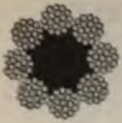
Diameter		Approximate Circumference		Approximate Weight		Approximate Breaking Stress		Diameter of Drum or Sheave Advised	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Feet	Meters
1½	38	4¾	121	3.19	4.75	58	52600	3.75	1.14
1⅜	35	4¼	108	2.70	4.02	51	46250	3.5	1.07
1¼	32	4	102	2.20	3.27	42	38100	3.2	0.98
1⅛	29	3½	89	1.80	2.68	34	30850	2.83	0.86
1	25	3	76	1.42	2.11	26	23600	2.5	0.76
⅞	22	2¾	70	1.08	1.61	20	18150	2.16	0.66
¾	19	2¼	57	0.80	1.19	15.3	13900	1.83	0.56
⅝	16	2	51	0.56	0.83	10.9	9900	1.75	0.53
9/16	14	1¾	44	0.45	0.67	8.7	7900	1.5	0.46
½	13	1½	38	0.35	0.52	7.3	6600	1.33	0.41
7/16	11	1¼	32	0.27	0.40	5.7	5150	1.16	0.35
⅜	9.5	1⅛	29	0.20	0.30	4.2	3800	1	0.30
5/16	8	1	25	0.13	0.19	2.75	2500	0.83	0.25
¼	6.5	¾	19	0.09	0.13	1.80	1650	0.75	0.23

This rope has two more strands and smaller wires than the regular 6 strand rope, and is especially adapted to running over comparatively small sheaves on derricks, steam dredges, coal handling machinery, cargo hoists, pile drivers and for logging purposes, for tubing lines in oil districts, etc. On account of the somewhat larger hemp center, the strength is a trifle less than that of the regular 6 strand rope; but under many conditions where extreme pliability is required, this extra flexible rope, owing to its ability to withstand severe bending, retains its strength longer than the stiffer 6 strand rope.

For proper working loads, see page 85.

This rope, when galvanized, is known as our GALVANIZED EXTRA FLEXIBLE CRUCIBLE CAST STEEL HOISTING ROPE. It is much more pliable than the 6 strand running rope and is preferred by the leading yachtsmen.

Also made in EXTRA STRONG CRUCIBLE CAST STEEL quality. For particulars, see special Wire Rope catalogue.



EXTRA FLEXIBLE PLOW STEEL HOISTING ROPE

NINETEEN WIRES TO THE STRAND. EIGHT STRANDS—ONE HEMP CENTER

Diameter		Approximate Circumference		Approximate Weight		Approximate Breaking Stress		Diameter of Drum or Sheave Advised	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Feet	Meters
1½	38	4¾	121	3.19	4.75	74	67100	3.75	1.14
1⅜	35	4¼	108	2.70	4.02	64	58050	3.5	1.07
1¼	32	4	102	2.20	3.27	52	47150	3.2	0.98
1⅛	29	3½	89	1.80	2.68	43	39000	2.83	0.86
1	25	3	76	1.42	2.11	33	29950	2.5	0.76
⅞	22	2¾	70	1.08	1.61	26	23600	2.16	0.66
¾	19	2¼	57	0.80	1.19	20	18150	1.83	0.56
⅝	16	2	51	0.56	0.83	14	12700	1.75	0.53
9/16	14	1¾	44	0.45	0.67	11.6	10500	1.50	0.46
½	13	1½	38	0.35	0.52	8.7	7900	1.33	0.41
7/16	11	1¼	32	0.27	0.40	6.90	6250	1.16	0.35
⅜	9.5	1⅛	29	0.20	0.30	5.12	4650	1	0.30
5/16	8	1	25	0.13	0.19	3.35	3050	0.83	0.25
¼	6	¾	19	0.09	0.13	2.25	2050	0.75	0.23

This rope has two more strands and smaller wires than the regular 6 strand rope, and is especially adapted for running over comparatively small sheaves on derricks, steam dredges, coal handling machinery, cargo hoists, pile drivers and for logging purposes.

On account of the somewhat larger hemp center, the strength is a trifle less than that of the regular 6 strand rope; but under many conditions where extreme pliability is required, this extra flexible rope, owing to its ability to withstand severe bending, retains its strength longer than the stiffer 6 strand rope.

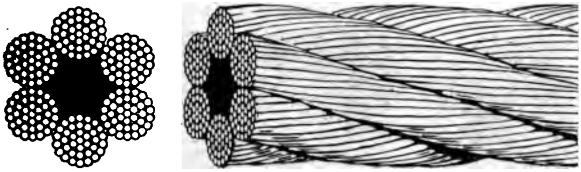
For proper working loads, see page 85.

This rope when galvanized is known as our GALVANIZED EXTRA FLEXIBLE PLOW STEEL HOISTING ROPE. It is much more pliable than the 6 strand running rope and is preferred by the leading yachtsmen.

Also made in MONITOR PLOW STEEL quality; for particulars, see special Wire Rope catalogue.

SPECIAL FLEXIBLE HOISTING ROPE

THIRTY-SEVEN WIRES TO THE STRAND—SIX STRANDS—ONE HEMP CORE



This rope is composed of 6 strands of 37 wires each, laid around a hemp core. It is a very flexible rope and much used on cranes and similar machinery where sheaves are, of necessity, rather small. Its wires are smaller than in the 6-strand 19-wire rope and consequently will not stand as much abrasive wear. It is a very efficient rope because a little over 50 per cent of the wires—and consequently over 50 per cent of the strength—are in the inner layers of the strand, protected from abrasion. This explains its particular advantage in addition to its flexibility. Hoisting rope larger than 1¾ inches is usually made of 6 strands of 37 wires each, rather than of 6 strands of 19 wires.

Special Flexible Hoisting Rope is made in five grades:

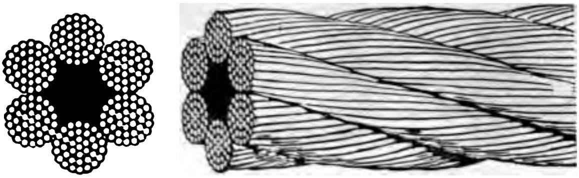
1. *Crucible Cast Steel.*
2. *Extra Strong Crucible Cast Steel.*
3. *Special Flexible Crane Rope (price same as Plow Steel).*
4. *Plow Steel.*
5. *Monitor or Improved Plow Steel and Tico Special.*

Special Flexible Crane Rope.—This is composed of 6 strands of 37 wires to the strand, with a hemp center, is sold from the plow steel list and is especially designed for service on electric cranes.

NOTE.—The term "Special Flexible" means 6 strands, 37 wires each, one hemp core. The words "Extra Flexible" mean 8 strands, 19 wires each, one hemp core.

SPECIAL FLEXIBLE CRUCIBLE CAST STEEL HOISTING ROPE

THIRTY-SEVEN WIRES TO THE STRAND. SIX STRANDS—ONE HEMP CORE



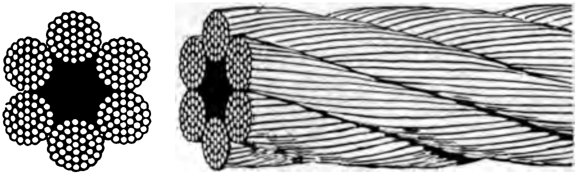
Diameter		Approximate Circumference		Approximate Weight		Approximate Breaking Stress		Diamet Drum c Sheave Advise
Inches	m m	Inches	m m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Feet
2¾	70	8⅝	219	11.95	17.78	200	181450	....
2½	64	7⅞	200	9.85	14.66	160	145150	....
2¼	57	7⅛	181	8.	11.90	125	113400	....
2	51	6¼	159	6.30	9.38	105	95250	....
1⅞	48	5¾	146	5.55	8.26	94	85300	....
1¾	44	5½	140	4.85	7.22	84	76200	....
1⅝	41	5	127	4.15	6.18	71	64400	....
1½	38	4¾	121	3.55	5.28	63	57150	3.75
1⅜	35	4¼	108	3.	4.46	55	49900	3.5
1¼	32	4	102	2.45	3.65	45	40800	3.2
1⅛	29	3½	89	2.	2.98	34	30850	2.83
1	25	3	76	1.58	2.35	29	26300	2.5
⅞	22	2¾	70	1.20	1.79	23	20850	2.16
¾	19	2¼	57	0.89	1.32	17.5	15900	1.83
⅝	16	2	51	0.62	0.92	11.2	10150	1.75
9/16	14	1¾	44	0.50	0.74	9.5	8600	1.5
½	13	1½	38	0.39	0.58	7.25	6600	1.33
7/16	11	1¼	32	0.30	0.45	5.5	5000	1.16
⅜	9.5	1⅛	29	0.22	0.33	4.2	3800	1.

For proper working loads, see page 88.

Rope of this construction may be used for general hoisting work loads are moderate and where sheaves are small. It is a stronger constr than the extra flexible, but somewhat more expensive, and its wires w stand as much abrasion as the 6 x 19 construction.

SPECIAL FLEXIBLE PLOW STEEL HOISTING ROPE

THIRTY-SEVEN WIRES TO THE STRAND. SIX STRANDS—
ONE HEMP CORE

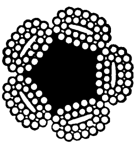


ameter	Approximate Circumference		Approximate Weight		Approximate Breaking Stress		Diameter of Drum or Sheave Advised	
m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Feet	Meters
70	8⅝	219	11.95	17.78	265	240400	....	....
64	7⅞	200	9.85	14.66	214	194100	....	....
57	7⅛	181	8.	11.90	175	158750	....	....
51	6¼	159	6.30	9.38	130	118000	....	....
48	5¾	146	5.55	8.26	119	108000	....	....
44	5½	140	4.85	7.22	108	98000	....	....
41	5	127	4.15	6.18	90	81650	....	....
38	4¾	121	3.55	5.28	80	72500	3.75	1.14
35	4¼	108	3.	4.46	68	61700	3.5	1.07
32	4	102	2.45	3.65	55	49900	3.2	0.98
29	3½	89	2.	2.98	44	39900	2.83	0.86
25	3	76	1.58	2.35	35	31750	2.5	0.76
22	2¾	70	1.20	1.79	27	24500	2.16	0.66
19	2¼	57	0.89	2.32	21	19000	1.83	0.56
16	2	51	0.62	0.92	14	12700	1.75	0.53
14	1¾	44	0.50	0.74	11.5	10400	1.5	0.46
13	1½	38	0.39	0.58	9.25	8400	1.33	0.41
11	1¼	32	0.30	0.45	7.2	6500	1.16	0.35
9.5	1⅛	29	0.22	0.33	5.1	4600	1.	0.30

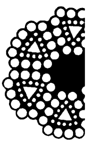
roper working loads, see page 85.

of this construction is largely used on electric traveling cranes, dredges,
ilar machinery, where loads are heavy and sheaves are, of necessity,
This rope is very efficient and gives excellent service where conditions
s use.

158153A



FLATTENED STRAND CRUCIBLE CAST STEEL HOISTING ROPE



Type A

Type

Type A—5 strands, 28 wires to the strand, one hemp core.

Type B—6 strands, 25 wires to the strand, one hemp core.

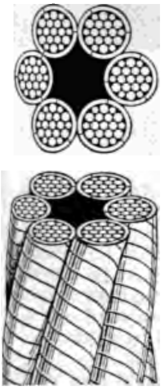
Diameter		Type A				Type B				Diame Drur She Advi
		Approximate Weight		Approximate Breaking Stress		Approximate Weight		Approximate Breaking Stress		
Ins.	m/m	Per Foot, Lbs.	Per Meter, Kilos	Tons of 2000 Lbs.	Kilos	Per Foot, Lbs.	Per Meter, Kilos	Tons of 2000 Lbs.	Kilos	Feet
2¼	57	8.00	11.90	133	120700	9.20	13.69	146	132450	8½
2	51	6.30	9.38	106	96150	7.25	10.79	117	106150	8
1¾	44	4.85	7.22	85	77100	5.60	8.33	94	85300	7¼
1⅝	41	4.15	6.18	72	65300	4.75	7.07	79	71650	6¼
1½	38	3.55	5.28	64	58050	4.00	5.95	70	63500	5¾
1⅜	35	3.00	4.46	56	50800	3.45	5.13	62	56250	5½
1¼	32	2.45	3.65	47	42650	2.80	4.17	52	47150	5
1⅛	29	2.00	2.98	38	34450	2.30	3.42	42	38100	4½
1	25	1.58	2.35	30	27250	1.80	2.68	33	29950	4
⅞	22	1.20	1.79	23	20850	1.38	2.05	25	22700	3½
¾	19	0.89	1.32	17.5	15900	1.00	1.49	19.3	17500	3
⅝	16	0.62	0.92	12.5	11350	0.72	1.07	13.8	12500	2¼
9/16	14	0.50	0.74	10	9050	0.58	0.86	11	10000	1¾
½	13	0.39	0.58	8.4	7600	0.45	0.67	9.3	8450	1½

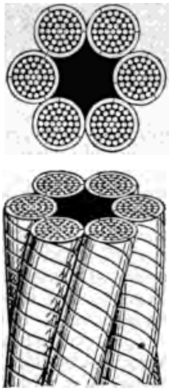
For proper working loads, see page 85.

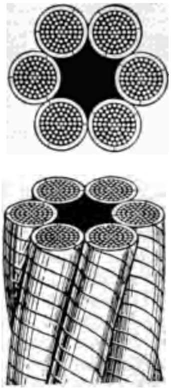
Also made in IRON, EXTRA STRONG CRUCIBLE CAST STEEL MONITOR PLOW STEEL qualities; for particulars, see special Rope catalogue.

STEEL CLAD HOISTING ROPE

6 Strands—19 Wires to the Strand—1 Hemp Core
6 Strands—37 Wires to the Strand—1 Hemp Core
6 Strands—61 Wires to the Strand—1 Hemp Core







Steel Clad Ropes. Are made in three constructions for the purpose of uring different degrees of flexibility. These constructions are the 6 x 19, 37 and 6 x 61 types, each of which is furnished in four grades:

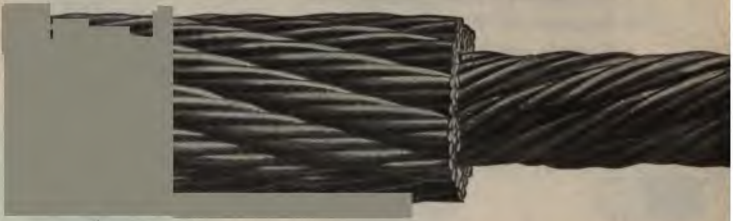
1. *Crucible Cast Steel.*
2. *Extra Strong Crucible Cast Steel.*
3. *Plow Steel.*
4. *Monitor or Improved Plow Steel.*

The flat strips of steel which are wound spirally around each of the six rands composing the rope, give it additional wearing surface without sacrificg the flexibility in any way. When the outer flat steel winding is worn rough in service, a complete hoisting rope remains, with unimpaired strength, e flat strip having served to protect the inner wires from all wear up to this oint. The worn flat strips naturally crowd down between the strands of the ope, and in this manner they provide additional wearing surface for the rope here it runs over sheaves or drums.

These ropes are designed to meet very severe conditions of service. The ncreased life obtained by the use of steel clad rope easily offsets any increased irst cost. In many places where conditions are suitable, additional service of from 50 to 100 per cent is frequently obtained.

AMERICAN NON-SPINNING HOISTING ROPE

Eighteen strands, composed of 7 wires each, one hemp core



Side view of American Non-Spinning Rope, showing exact lay of inside
outside wires

Non-Spinning Hoisting Rope is built up as follows: First, 6 strand
7 wires each, Lang Lay (wires in the strands and strands themselves twi
to the left), are laid around a hemp core; second, these strands are then cov
with an outer layer composed of 12 strands, 7 wires, Regular Lay (wir
the strands twisted to the left and strands themselves twisted to the rig

The function of this combination of lays is to prevent a free load suspen
on the end of a single line from rotating. The spinning of a load endan
the lives of employees, and the constant attention required to guide the
in its ascent not only means extra trouble but expense as well.

We recommend this type of rope for "back-haul" or single line derri
also for shaft sinking and mine hoisting where bucket or cage swings
without guides.

Non-spinning rope works best where it does not overwind on drum.

Either a closed socket or an open socket makes the best fastening on
end of Non-spinning rope.

Closed Socket

Open Socket

AMERICAN NON-SPINNING HOISTING ROPE

18 strands, 7 wires each, one hemp core

IRON

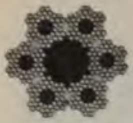
Diameter		Approximate Weight		Approximate Breaking Stress		Proper Working Load		Diameter of Drum or Sheave Advised	
Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Tons of 2000 Pounds	Kilos	Feet	Meters
1¾	44	5.50	8.19	45.80	41550	9.1	8250	7	2.13
1⅝	41	4.90	7.29	39.80	36100	7.9	7150	6½	1.98
1½	38	4.32	6.43	34.00	30850	6.8	6150	6	1.83
1⅜	35	3.60	5.36	28.20	25600	5.6	5100	5½	1.68
1¼	32	2.80	4.17	23.40	21250	4.6	4150	5	1.52
1⅛	29	2.34	3.48	19.60	17800	3.9	3550	4½	1.37
1	25	1.73	2.57	14.95	13550	2.9	2650	4	1.22
⅞	22	1.44	2.14	11.95	10850	2.3	2100	3½	1.07
¾	19	1.02	1.52	8.85	8050	1.7	1550	3	0.91
⅝	16	0.70	1.04	5.90	5350	1.1	1000	2½	0.76
9/16	14	0.57	0.85	4.85	4400	.97	880	2¼	0.69
½	13	0.42	0.63	3.65	3300	.73	660	2	0.61
7/16	11	0.31	0.46	2.63	2400	.52	470	1¾	0.53
⅜	9.5	0.25	0.37	2.10	1900	.42	380	1½	0.46

CRUCIBLE CAST STEEL

Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Tons of 2000 Pounds	Kilos	Feet	Meters
1¾	44	5.50	8.19	85.90	77900	17.1	15500	7	2.13
1⅝	41	4.90	7.29	74.40	67500	14.8	13450	6½	1.98
1½	38	4.32	6.43	63.80	57900	12.7	11500	6	1.83
1⅜	35	3.60	5.36	52.00	47200	10.4	9450	5½	1.68
1¼	32	2.80	4.17	43.80	39750	8.7	7900	5	1.52
1⅛	29	2.34	3.48	36.80	33400	7.3	6600	4½	1.37
1	25	1.73	2.57	28.00	25400	5.6	5100	4	1.22
⅞	22	1.44	2.14	22.50	20400	4.5	4100	3½	1.07
¾	19	1.02	1.52	16.70	15150	3.3	3000	3	0.91
⅝	16	0.70	1.04	11.10	10050	2.2	2000	2½	0.76
9/16	14	0.57	0.85	9.10	8250	1.8	1650	2¼	0.69
½	13	0.42	0.63	6.90	6250	1.3	1200	2	0.61
7/16	11	0.31	0.46	4.90	4450	.98	890	1¾	0.53
⅜	9.5	0.25	0.37	3.90	3550	.78	700	1½	0.46

Also made in EXTRA STRONG CRUCIBLE STEEL, PLOW STEEL, and MONITOR PLOW STEEL qualities; for particulars, see special Wire Rope catalogue.

IRON OR CAST STEEL TILLER ROPE, OR HAND ROPE



Six Strands of Forty-Two Wires Each (252 Wires in Al
Seven Hemp Cores

Diameter		Approximate Circumference		Approximate Weight	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos
1	25	3	76	1.10	1.64
7/8	22	2 3/4	70	0.84	1.25
3/4	19	2 1/4	57	0.62	0.92
5/8	16	2	51	0.43	0.64
9/16	14	1 3/4	44	0.35	0.52
1/2	13	1 1/2	38	0.28	0.42
7/16	11	1 1/4	32	0.21	0.31
3/8	9.5	1 1/8	29	0.16	0.24
5/16	8	1	25	0.11	0.164
1/4	6	3/4	19	0.07	0.104

The wires are very fine. Care should be taken not to subject it to muc abrasive wear.

It is used to a limited extent for steering lines on yachts and motor boat Galvanized Crucible Cast Steel Yacht Rope, 6 strands, 19 wires to the stran 1 hemp core, is preferred by many for motor boats.

Three-eighth and ½-inch diameter Iron Tiller or Hand Rope is used f starting and stopping elevators. This rope is also called Elevator Shipper Ro

Tiller Rope of tinned or galvanized iron or steel is furnished if required.

AERIAL WIRE ROPE TRAMWAYS

(Aerial Transporters—Wire Ropeways)

We design complete plants for the following purposes:

Transportation of ores, stone, coal, timber, agricultural products, material loose or in bags, barrels or boxes, and semi-finished articles of manufacture.

Removal of mine or quarry wastage, slag, ashes, etc.

Creation of storage piles.

Transportation of finished and semi-finished articles between buildings or in buildings in industrial plants.

Transportation of passengers.

Designs and estimates furnished, for which purpose intending purchasers should supply us with profile, statement of hourly capacity, and weight per cubic foot or dimensions of material to be handled. Tramways may develop or require power in their operation. Inquiries should state the kind of power available and, if electric, the characteristics of the current.

The following equipment is supplied with Aerial Tramways:

Track Cables: Locked coil, locked wire or smooth coil, with couplings and fittings.

Traction Rope: Transmission rope.

Carriers: Carriages (trolleys) with hangers, buckets or receptacles of special design, compression grips.

For Supports: Saddles, bearings, rollers, guides. For wooden structures we furnish working drawings, timber lists, bolts and washers. Structural steel furnished when required.

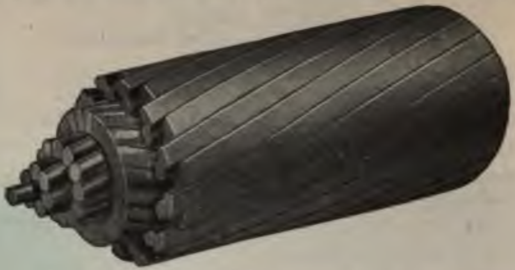
For Terminals: Driving sheaves, guide sheaves, shafts, bearings, gears, tension mechanism, power connections, anchorage fittings, rails, automatic attachers and detachers, chutes, bolts, etc.

Complete Working Drawings.

Tools: For coupling and splicing cables and traction ropes.

When Necessary: Reverse preventers, speed indicating alarm, brakes, automatic braking devices, track scales, oilers for cables or traction rope, etc., telephones.

TRACK CABLES FOR AERIAL TRAMWAYS



Locked-Coil Aerial Tramway Track Cable

Diameter		Approximate Circumference		Approximate Weight		Approximate Breaking Stress	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos
1⅝	41.28	5⅛	130.18	6.30	9.3756	103	93450
1½	38.10	4¾	120.65	5.30	7.8874	89	80750
1⅜	34.93	4¼	107.95	4.40	6.5480	75	68050
1¼	31.75	4	101.60	3.70	5.5062	62	56250
1⅛	28.58	3½	88.90	3.00	4.4645	50	45350
1	25.40	3	76.20	2.35	3.4973	40	36300
⅞	22.23	2¾	69.85	1.80	2.7008	30	27200

Locked Coil Cable is superior to all other types for use as stationary o track cable for Aerial Wire Rope Tramways. It is made of shaped wire so laid as to present a practically smooth surface, which results in minimum wear, both of the cable itself and the wheels passing over it. The outer wire interlock, so that should an individual wire break, it is restrained from protruding and engaging with the carrier. Specially designed swivel socket are furnished with this type of cable to permit of turning the cable as occasion may require, so that the wear may be distributed over the entire surface.

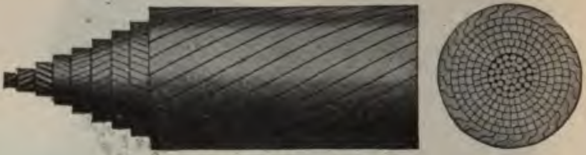
TRACK CABLES FOR AERIAL TRAMWAYS.—*Continued*

Smooth-Coil Aerial Tramway Track Cable

Diameter		Number of Wires in Strand	Weight		Approximate Breaking Stress			
					Crucible Steel		Plow Steel	
Inches	m/m		Per 100 Ft., [illegible]	Per 100 Meters, Kilos	Tons of 2000 Pounds	Kilos	Tons of 2000 Pounds	Kilos
2½	64	91	1310	1950	285.00	258500	335.00	303900
2¼	57	91	1036	1542	233.00	211400	266.00	241300
2⅛	54	91	935	1391	204.00	185000	240.00	217700
2	51	61	840	1250	185.00	167800	218.00	197800
1⅞	48	61	728	1083	161.00	146000	189.00	171500
1¾	44	61	659	981	145.80	132300	171.00	155100
1⅝	41	61	563	838	124.00	112500	146.00	132500
1½	38	37	488	726	108.40	98300	127.50	115700
1⅜	35	37	401	597	88.80	80500	105.00	95300
1¼	32	37	323	481	71.80	65100	84.60	76800
1⅛	29	37	270	402	60.00	54400	70.70	64100
1	25	19	220	327	49.20	44600	58.00	52600
⅞	22	19	169	251	37.60	34100	44.40	40300
¾	19	19	124	185	27.60	25000	32.50	29500
⅝	16	19	86	128	19.20	17400	22.30	20200

The above table gives the approximate strength of two different grades of track strand for wire rope tramways, which are now in very general use for transporting all kinds of material, for loading and unloading vessels, excavating, etc. These qualities of steel have been found the best for this particular purpose. This strand presents a comparatively smooth surface for the travelers to run upon. The plow steel quality affords the greatest strength with the least weight—a very important advantage, especially in long spans.

TRACK CABLES FOR AERIAL TRAMWAYS.—*Continued*



Locked Wire Cable

Diameter		Approximate Circumference		Approximate Weight		Approxim Breaking S	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	
2½	64	7⅞	200	15.60	23.22	240	2
2¼	57	7⅛	181	12.50	18.60	190	1
2	51	6¼	159	10.00	14.88	160	1
1¾	44	5½	140	7.65	12.05	120	1
1⅝	41	5⅛	130	6.60	9.82	103	
1½	38	4¾	121	5.70	8.48	89	
1⅜	35	4¼	108	4.75	7.74	75	
1¼	32	4	102	3.80	5.66	62	
1⅛	29	3½	89	3.15	5.36	50	
1	25	3	76	2.50	3.72	40	
⅞	22	2¾	70	1.88	2.80	30	
¾	19	2¼	57	1.30	1.93	22	
⅝	16	2	51	.90	1.34	15½	
9/16	14	1¾	44	.72	1.07	12½	
½	13	1½	38	.57	.85	10	

This cable is a modification of the Locked Coil type. It is made same principle as Locked Coil but has a larger number of small sized wi the same diameter of cable. It is recommended for aerial conveying sy especially Cable Hoist Conveyors.

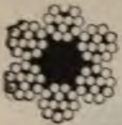
GALVANIZED WIRE ROPE

Used for all standing rope purposes. The advantages of using galvanized rope are readily apparent in all cases where exposure to the weather, constant or periodical moisture, etc., are among the conditions of use.

The same qualities of iron and steel are used in the galvanized rope as in the ungalvanized.

The galvanizing is done by special patented processes, which secure the most perfect adhesion of the zinc to the metal. It does not crack, chip nor flake, the weatherproof coating being practically a part of the wire itself.

On the following pages we give particulars of the sizes, weights, approximate breaking stresses, etc., of some of the principal types of galvanized rope and strand usually furnished. For further details and information, see special Wire Rope catalogue.



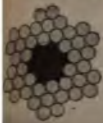
GALVANIZED IRON WIRE ROPE FOR SHI RIGGING, GUYS FOR DERRICKS AND SIMILAR USES

SEVEN OR TWELVE WIRES TO THE STRAND. SIX STRANDS—
HEMP CORE

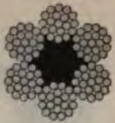
Approximate Diameter		Circumference		Approximate Weight		Approximate Breaking Stress		Circumfer New Ma Rope of E Strengt
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Inches
1¾	44	5½	140	4.85	7.22	42	38100	11
1 11/16	43	5¼	133	4.42	6.58	38	34450	10½
1⅝	41	5	127	4.15	6.18	35	31750	10
1½	38	4¾	121	3.55	5.28	30	27200	9½
1 7/16	37	4½	114	3.24	4.82	28	25400	9
1⅜	35	4¼	108	3	4.46	26	23600	8½
1¼	32	4	102	2.45	3.65	23	20850	8
1 3/16	30	3¾	95	2.21	3.29	19	17250	7½
1⅛	29	3½	89	2.	2.98	18	16350	6½
1 1/16	27	3¼	83	1.77	2.63	16.1	14600	6
1	25	3	76	1.58	2.35	14.1	12800	5¾
⅞	22	2¾	70	1.20	1.79	11.1	10050	5¼
13/16	21	2½	64	1.03	1.53	9.4	8550	5
¾	19	2¼	57	0.89	1.32	7.8	7100	4¾
⅝	16	2	51	0.62	0.92	5.7	5150	4½
9/16	14	1¾	44	0.50	0.74	4.46	4050	3¾
½	13	1½	38	0.39	0.58	3.39	3100	3
7/16	11	1¼	32	0.30	0.45	2.35	2150	2½
⅜	9.5	1⅛	29	0.22	0.33	1.95	1750	2¼
5/16	8	1	25	0.15	0.22	1.42	1300	2
(Following Sizes are Made with 5 Strands, 7 Wires Each)								
9/32	7	⅞	22	0.12	0.186	1.20	1100	1¾
¼	6.5	¾	19	0.09	0.134	0.99	900	1½
7/32	5.5	⅝	16	0.06	0.094	0.79	700	1¼
3/16	5	½	13	0.04	0.06	0.61	550	1⅛

For proper working loads, see page 85.
Also made with wire center, at an advance in price.

GALVANIZED CRUCIBLE CAST STEEL YACHT RIGGING OR GUY ROPE



SEVEN OR NINETEEN WIRES TO THE STRAND. SIX STRANDS—ONE HEMP CORE



Approximate Diameter		Circumference		Approximate Weight		Approximate Breaking Stress		Circumference New Manila Rope of Equal Strength	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Inches	m/m
1¼	32	4	102	2.45	3.65	42	38100	13	330
1 3/16	30	3¾	95	2.21	3.29	38	34450	12	305
1⅛	29	3½	89	2.00	2.98	34	30850	11	279
1 1/16	27	3¼	83	1.77	2.63	31	28100	10	254
1	25	3	76	1.58	2.35	28	25400	9	229
⅞	22	2¾	70	1.20	1.79	22	19950	8½	216
13/16	21	2½	64	1.03	1.53	19	17250	8	203
¾	19	2¼	57	0.89	1.32	16.8	15250	7	178
⅝	16	2	51	0.62	0.92	11.7	10600	6	152
9/16	14	1¾	44	0.50	0.74	9	8150	5¼	133
½	13	1½	38	0.39	0.58	7	6350	4¾	121
15/32	12	1⅜	35	0.34	0.51	6	5450	4½	114
7/16	11	1¼	32	0.30	0.45	5	4550	4¼	108
⅜	9.5	1⅛	29	0.22	0.33	4.2	3800	3¾	95
5/16	8	1	25	0.15	0.22	3.2	2900	3	76

Only the best grade of crucible cast steel is used in this rigging, combining great strength with light weight and small diameter.

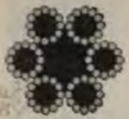
The style with 7 wires to the strand is used exclusively for standing rigging, while that with 19 wires to the strand, being more flexible, is used for hoists, outhauls, moorings and messenger lines.

For proper working loads, see page 85.

Galvanized extra flexible hoisting rope, 8 strands, 19 wires to the strand, for hoists, outhauls and mooring lines on yachts and for steamer hawsers, from ½ to 2 inches in diameter, made to order.

For galvanized crucible and plow steel yacht rope having a greater strength or pliability, see pages 87, 95 and 96.

GALVANIZED IRON AND CRUCIBLE CAST STEEL RUNNING ROPE

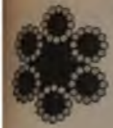


TWELVE WIRES TO THE STRAND. SIX STRANDS—SEVEN HEMP CORES

Approximate Diameter		Circumference		Approximate Weight		Approximate Breaking Stress			
						Iron		Crucible Cast Steel	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Tons of 2000 Pounds	Kilos
$1\frac{1}{16}$	27	$3\frac{1}{4}$	83	1.18	1.76	10.1	9200	22.5	20400
1	25	3	76	1.05	1.56	8.7	7900	19.5	17700
$\frac{7}{8}$	22	$2\frac{3}{4}$	70	0.80	1.19	6.9	6250	15.5	14050
$\frac{13}{16}$	21	$2\frac{1}{2}$	64	0.68	1.01	6	5450	13.5	12250
$\frac{3}{4}$	19	$2\frac{1}{4}$	57	0.59	0.88	5.1	4650	11.5	10450
$\frac{5}{8}$	16	2	51	0.42	0.63	3.6	3250	8	7250
$\frac{9}{16}$	14	$1\frac{3}{4}$	44	0.33	0.49	2.8	2550	6.5	5900
$\frac{1}{2}$	13	$1\frac{1}{2}$	38	0.26	0.39	2.2	2000	5	4550
$\frac{7}{16}$	11	$1\frac{1}{4}$	32	0.20	0.30	1.7	1550	3.9	3550
$\frac{3}{8}$	9.5	$1\frac{1}{8}$	29	0.14	0.21	1.3	1180	2.85	2600
$\frac{5}{16}$	8	1	25	0.10	0.15	0.82	740	1.98	1800

This rope is galvanized by a special process. It is designed especially for running rigging service where great flexibility is required and where exposure to moisture is frequent. Its weight is only about two-thirds that of ordinary hoisting or running rope of the same diameter.

For proper working loads, see page 85.



GALVANIZED STEEL HAWSERS AND MOORING LINES

TWELVE WIRES TO THE STRAND. SIX STRANDS—SEVEN HEMP CORES

Approximate Diameter		Circumference		Approximate Weight		Approximate Breaking Stress		Circumference New Manila Hawser of Equal Strength	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Inches	m/m
2 1/16	52	6½	165	4.43	6.59	83	75300	......	....
2	51	6¼	159	4.20	6.25	77	69850	......	....
1 15/16	49	6	152	3.89	5.79	71	64400	......	....
1 13/16	46	5¾	146	3.42	5.09	66	59850	......	....
1¾	44	5½	140	3.23	4.81	61	55300	13½	343
1 11/16	43	5¼	133	2.94	4.38	57	51700	13	330
1⅝	41	5	127	2.76	4.11	53	48100	12½	318
1½	38	4¾	121	2.36	3.51	45	40800	12	305
1 7/16	37	4½	114	2.16	3.21	41	37200	11½	292
1⅜	35	4¼	108	2.00	2.98	38	34450	11	279
1¼	32	4	102	1.63	2.43	31	28100	10	254
1 3/16	30	3¾	95	1.47	2.19	28	25400	9¼	235
1⅛	29	3½	89	1.33	1.98	26	23600	8¾	222

For proper working loads, see page 85.

For smaller sizes, see Galvanized Running Rope, page 112.

For galvanized cast steel mooring lines of 6 strands, 19 wires to the strand, see page 111.

Also made 24 wires to the strand, 6 strands, 7 hemp cores; for particulars, see Wire Rope catalogue.

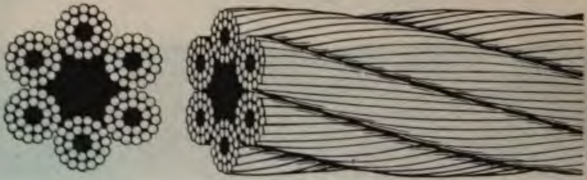
The great advantage of galvanized steel hawsers over manila or hemp hawsers is in the smaller cost, bulk and weight, for hawsers of equal strength.

Galvanized steel hawsers are made from the best grade of crucible cast steel, and are from three to four times stronger than manila or hemp hawsers of equal size.

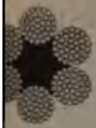
Galvanized steel hawsers are more flexible and much more durable than manila or hemp hawsers of the same strength.

GALVANIZED STEEL HAWSERS AND MOORING LINES

TWENTY-FOUR WIRES TO THE STRAND. SIX STRANDS—SEVEN HEMP CORES



Approximate Diameter		Circumference		Approximate Weight		Approximate Breaking Stress		Circumfer New Ma Hawser of I Strengt
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Inches
2 1/16	52	6 1/2	165	5.81	8.65	113	102500	.....
2	51	6 1/4	159	5.51	8.20	106	96150	.....
1 15/16	49	6	152	5.09	7.58	98	88900	.....
1 13/16	46	5 3/4	146	4.48	6.67	88	79800	.....
1 3/4	44	5 1/2	140	4.24	6.31	82	74400	.....
1 11/16	43	5 1/4	137	3.86	5.74	76	68950	.....
1 5/8	41	5	127	3.63	5.40	74	67100	.....
1 1/2	38	4 3/4	121	3.10	4.61	63	57150	13.5
1 7/16	37	4 1/2	114	2.92	4.35	55	49900	13.0
1 3/8	35	4 1/4	108	2.62	3.90	50	45350	12.0
1 1/4	32	4	102	2.15	3.20	42	38100	12.0
1 3/16	30	3 3/4	95	1.93	2.87	38	34500	11.0
1 1/8	29	3 1/2	89	1.75	2.60	34	30800	10.25
1 1/16	27	3 1/4	83	1.54	2.29	27	24500	9.25
1	25	3	76	1.38	2.05	25	22700	8.75
7/8	22	2 3/4	70	1.05	1.56	20	18100	.....
13/16	21	2 1/2	64	0.90	1.34	17	15400	.....
3/4	19	2 1/4	57	0.78	1.16	14	12700	.....
5/8	16	2	51	0.54	0.80	10.5	9500	.....
1/2	13	1 1/2	38	0.34	0.51	6.6	6000	.....
3/8	9.5	1 1/8	29	0.21	0.31	4.	3600	.....



GALVANIZED STEEL DEEP SEA TOWING HAWSERS

THIRTY-SEVEN WIRES TO THE STRAND. SIX STRANDS —ONE HEMP CORE

Approximate Diameter		Approximate Circumference		Approximate Weight		Approximate Breaking Stress	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos
2 3/8	60	7 1/2	191	8.82	13.13	188	170550
2 5/16	59	7 1/4	184	8.36	12.44	182	165100
2 1/4	57	7 1/8	181	8	11.91	171	155100
2 1/8	54	6 3/4	171	7.06	10.51	155	140600
2 1/16	52	6 1/2	165	6.65	9.90	140	127000
2	51	6 1/4	159	6.30	9.38	132	119750
1 15/16	49	6	152	5.84	8.69	125	113400
1 13/16	46	5 3/4	146	5.13	7.63	112	101600
1 3/4	44	5 1/2	140	4.85	7.22	104	94350
1 11/16	43	5 1/4	133	4.42	6.58	97	88000
1 5/8	41	5	127	4.15	6.18	87	78900
1 1/2	38	4 3/4	121	3.55	5.28	76	68950
1 7/16	37	4 1/2	114	3.24	4.82	72	65300
1 3/8	35	4 1/4	108	3	4.46	66	59900
1 1/4	32	4	102	2.45	3.65	54	49000
1 3/16	30	3 3/4	95	2.21	3.29	47	42650
1 1/8	29	3 1/2	89	2	2.98	42	38100
1 1/16	27	3 1/4	83	1.77	2.63	38	34450
1	25	3	76	1.58	2.35	31.5	28550
7/8	22	2 3/4	70	1.20	1.79	26	23600
13/16	21	2 1/2	64	1.03	1.53	22	19950
3/4	19	2 1/4	57	0.89	1.32	20	18150

These hawsers are designed especially for heavy sea, river and lake towing, in connection with automatic steam towing machines, which maintain a uniform tension on the hawsers. They are only furnished galvanized.

For proper working loads, see page 85.

GALVANIZED STEEL CABLES FOR SUSPENSION BRIDGES

Composed of Six Strands, with Wire Center

Approximate Diameter		Approximate Circumference		Approximate Weight		Approximate Breaking Stress	
Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos
2¾	70	8⅝	219	12.70	18.90	310	281000
2⅝	67	8¼	210	11.60	17.26	283	257000
2½	64	7⅞	200	10.50	15.63	256	232000
2⅜	60	7½	191	9.50	14.14	232	210000
2¼	57	7⅛	181	8.52	12.68	208	189000
2⅛	54	6⅝	168	7.60	11.31	185	168000
2	51	6¼	159	6.73	10.02	164	149000
1⅞	48	5⅞	149	5.90	8.78	144	130000
1¾	44	5½	140	5.10	7.59	124	112000
1⅝	41	5	127	4.34	6.46	106	96000
1½	38	4¾	[illegible]	3.70	5.51	90	82000
1⅜	35	4¼	108	3.10	4.61	75	68000
1¼	32	4	[illegible]	2.57	3.82	62	56000

The strengths given are of cables made from the best crucible steel of 170,000 lbs. tensile strength per square inch (119.52 kilos per square millimeter). Galvanized plow steel cables of 190,000 lbs. per square inch (133.58 kilos per square millimeter) can be furnished. The steel used in these cables is manufactured and galvanized in our own works.

We are prepared to supply cables fitted with special bridge sockets ready for attaching to anchorage bolts.

Prices on these cables furnished upon application.

GALVANIZED AND EXTRA GALVANIZED STRAND

SEVEN OR NINETEEN STEEL WIRES TWISTED INTO A SINGLE STRAND

even Steel Wires Twisted into a Single Strand, Galvanized or Extra Galvanized

Seizing Strand Trade umber	Diameter		Approximate Weight		Approximate Strength	
	Inches	m/m	Per 1000 Feet, Pounds	Per 100 Meters, Kilos	Pounds	Kilos
	3/4	19.0	1200	179	18000	8165
	5/8	15.9	800	119	14000	6350
	9/16	14.3	650	97	11000	4990
	1/2	12.7	510	76	8500	3856
	7/16	11.1	415	62	6500	2948
	3/8	9.5	295	44	5000	2268
	5/16	7.9	210	31	3800	1724
	9/32	7.1	160	24	2800	1270
	1/4	6.4	125	19	2300	1043
	7/32	5.6	95	14	1800	816
	3/16	4.8	75	11	1400	635
	5/32	4.0	55	8	900	508
18	9/64	3.6	40	6	700	318
19	1/8	3.2	32	4.8	500	227
20	7/64	2.8	25	3.7	450	204
21	3/32	2.4	20	3.0	400	181
22	5/64	2.0	13	1.9	300	136

ineteen Wires Twisted into a Single Strand, Galvanized or Extra Galvanized

	1	25.4	2100	312	32000	14500
	7/8	22.2	1610	240	24000	10890
	3/4	19.0	1200	179	18000	8165
	5/8	15.9	800	119	14000	6350
	9/16	14.3	650	97	11000	4990
	1/2	12.7	510	76	8500	3856

This strand is used chiefly for guying poles and smoke stacks, for support- g trolley wire, and for operating railroad signals. For overhead catenary nstruction of suspending trolley wire, the special grades of strand are con- dered preferable because they possess greater strength and toughness.

The last five sizes listed are sometimes called Galvanized Seizing Strand, sed for seizing or binding the ends of wire rope and thimble splices, and for ying rope into coils.

EXTRA GALVANIZED SPECIAL STRAND

SEVEN OR NINETEEN STEEL WIRES TWISTED INTO A SINGLE STRAND

We furnish three special grades of Extra Galvanized Strand that should meet all requirements for durability, strength, toughness and light weight.

Extra Galvanized Siemens-Martin Strand.

Extra Galvanized High Strength (Crucible Steel) Strand.

Extra Galvanized Extra High Strength (Plow Steel) Strand.

All three qualities are composed of seven or nineteen wires having the heaviest coating of galvanizing that will ensure the longest life.

Seven Steel Wires Twisted into a Single Strand

Diameter		Tensile Strength					
		Siemens-Martin		High Strength		Extra High Strength	
Inches	m/m	Pounds	Kilos	Pounds	Kilos	Pounds	Kilos
5/8	15.9	19000	8618	25000	11340	42500	19278
9/16	14.3	15000	6804	21500	9525	35000	15876
1/2	12.7	11000	4990	18000	8165	27000	12247
7/16	11.1	9000	4082	15000	6804	22500	10206
3/8	9.5	6800	3084	11500	5217	17250	7825
5/16	7.9	4860	2205	8100	3674	12100	5488
9/32	7.1	4380	1987	7300	3311	10900	4944
1/4	6.4	3060	1388	5100	2313	7600	3447
3/16	4.8	2000	907	3300	1497	4900	2223
1/8	3.2	900	408	1500	680	2250	1021

Nineteen Steel Wires Twisted into a Single Strand

1	25.4	51000	23134	87400	39644	120000	54430
7/8	22.2	38000	17237	64000	29030	90000	40824
3/4	19.0	28400	12882	47400	21500	70000	31752
5/8	15.9	20000	9072	33000	14969	47000	21319
9/16	14.3	15000	6804	22000	9979	38000	17237
1/2	12.7	11000	4990	18000	8165	27000	12247
7/16	11.1	9000	4082	15000	6804	22500	10206
3/8	9.5	6800	3085	11500	5216	17250	7825

OIL WELL LINES

American Wire Drilling Line

This line is made of special grade steel peculiarly adapted for drilling purses. The method of construction, and the quality of core used, impart necessary elasticity so essential in a drilling line.

It can be manufactured in all sizes, but the ¾-inch (19.05 m/m) and ⅞-h (22.23 m/m) diameters are in most common use.

Crucible Cast Steel Wire Sand Line

A large supply of these lines, ⅜-inch (9.53 m/m), ½-inch (12.70 m/m) and -inch (14.29 m/m) diameter sizes, carried in stock. This quality of sand ne has been manufactured for years and is found to give the best satisfacon on sand pumps. Any size desired made to order quickly.

Crucible Cast Steel Wire Tubing, Casing or Dead Line

These lines have great strength and flexibility. Double dead lines spliced ndless, or single lines with loops spliced in the ends, made to order quickly.

Special Galvanized Sucker Rod or Connecting Strand

This strand is made from steel of great strength and stiffness. It is especilly adapted for operating a series of pumps from a single engine, the strand eing used to connect the several pump levers. Sizes ½-inch (12.70 m/m), -inch (15.88 m/m), and ¾-inch (19.05 m/m) diameter are carried in stock.

For further particulars, see special oil well catalogue of wire lines and applinces.

CAST STEEL FLAT ROPE

Flat rope is composed of a number of wire ropes called "flat rope strand of alternate right and left lay, placed side by side, then secured or sew together with soft iron or steel wire, thus forming a completed rope as show in the cut. The sewing or filling wires, being so much softer than the ste wires composing the strands of the rope, act as a cushion or soft bed for th strands, and wear out much faster than the harder wires composing the latter. When the sewing wires are worn out the flat rope can be resewed with new wire, and if any of the rope strands are also worn or damaged these can be replaced by new portions. In fact, flat ropes admit of being repaired by the replacing of any defective part. Strands of any kind, size or quality can be furnished. Iron sewing wire can be furnished promptly to customers who wish to repair or sew their flat rope at the mine.

Flat rope is used principally for hoisting purposes. When large and long rope is used in hoisting heavy loads out of deep shafts, round rope requires large and heavy drums on which to wind; while flat rope, winding on itself, needs a reel very little wider than the width of the rope. When space for machinery is an object, the advantage of using the style of rope requiring the smallest reel is obvious. Furthermore, flat rope does not spin or twist in the shaft. Flat rope is manufactured of high grade crucible cast steel, but is also made of either iron or plow steel. Flat rope can be furnished from 1¾ inches to 8 inches (44.45 to 203 m/m) in width, and from ¼ inch to ⅞ inch (6.35 to 22.23 m/m) in thickness, the length varying from 20 to 3000 feet (6 to 914 meters).

FLAT WIRE ROPE

MADE OF CRUCIBLE STEEL

*½ INCH (12.70 m/m) THICK

dth and Thickness		Weight		Approximate Breaking Stress		Approximate Working Load	
hes	m/m	Per Foot, Pounds	Per Meter, Kilos	Tons of 2000 Pounds	Kilos	Tons of 2000 Pounds	Kilos
7	12.7 x 178	5.90	8.78	128	116100	25.6	23200
6	12.7 x 152	4.90	7.29	105	95200	21.0	19050
5½	12.7 x 140	4.55	6.77	98	88900	19.6	17800
5	12.7 x 127	4.20	6.25	90	81600	18.0	16350
4½	12.7 x 114	3.85	5.73	83	75300	16.6	15050
4	12.7 x 102	3.15	4.69	69	62600	13.8	12500
x 3½	12.7 x 89	2.80	4.17	60	54400	12.0	10900
x 3	12.7 x 76	2.50	3.72	52	47200	10.4	9450
x 2½	12.7 x 64	2.20	3.27	45	40800	9.0	8150

*⅜ INCH (9.525 m/m) THICK

x 6	9.5 x 152	3.73	5.55	81	73500	16.2	14700
x 5½	9.5 x 140	3.50	5.21	77	69900	15.4	13950
x 5	9.5 x 127	3.10	4.61	68	61700	13.6	12350
x 4½	9.5 x 114	2.85	4.24	63	57200	12.6	11450
x 4	9.5 x 102	2.43	3.62	54	49000	10.8	9800
x 3½	9.5 x 89	2.30	3.42	50	45400	10.0	9050
x 3	9.5 x 76	1.89	2.81	41	37200	8.2	7450
x 2½	9.5 x 64	1.70	2.53	36	32700	7.2	6550
2	9.5 x 51	1.30	1.93	27	24500	5.4	4900

Unless order distinctly specifies the contrary, thickness is understood to ly to size of strand before sewing. Made also ¼″ (6.35 m/m), $\frac{5}{16}$″ (7.94 n), ⅝″ (15.88 m/m), ¾″ (19.05 m/m) and ⅞″ (22.23 m/m) thick. Made of Plow Steel. See Wire rope catalogue.

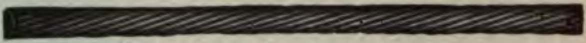
GALVANIZED CLOTHES LINES

HOLLOW CABLE

No. 1. 7 wires, No. 22 gauge (0.73 m/m)

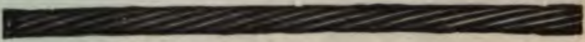
No. 2. 9 wires, No. 22 gauge (0.73 m/m)

No. 3. 12 wires, No. 22 gauge (0.73 m/m)

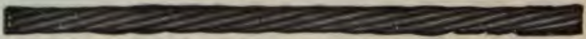


No. 4. 11 wires, No. 20 gauge (0.88 m/m)

TWISTED

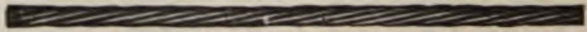


No. 17. 6 wires, No. 17 gauge (1.37 m/m)



No. 18. 6 wires, No. 18 gauge (1.21 m/m)

No. 19. 6 wires, No. 19 gauge (1.04 m/m)



No. 20. 6 wires, No. 20 gauge (0.88 m/m)

Prices quoted per dozen coils.

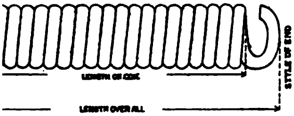
Put up in coils of 40, 50, 60, 75 and 100 feet (12.19, 15.24, 18.29, 22.86 and 30.48 meters) and packed in barrels; also on reels of 2500 and 5000 feet (762 and 1524 meters).

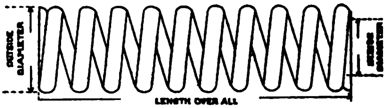
ESTIMATED AVERAGE WEIGHT PER DOZEN							ESTIMATED AVERAGE NUMBER OF DOZEN TO BARREL			
Sizes	100 Feet (30.48 Meters)		75 Feet (22.86 Meters)		50 Feet (15.24 Meters)		Sizes	100 Ft.	75 Ft.	50 Ft.
	Pounds	Kilos	Pounds	Kilos	Pounds	Kilos				
No. 1	18	8.16	14	6.35	9	4.08	No. 1	12	15	24
No. 2	22	9.98	17	7.71	11	4.99	No. 2	8	12	16
No. 3	30	13.61	23	10.43	15	6.80	No. 3	6	8	12
No. 4	42	19.05	32	14.51	21	9.53	No. 4	5	8	10
No.17	56	25.40	42	19.05	28	12.70	No. 17	5	6	8
No.18	46	20.87	35	15.88	24	10.89	No. 18	6	7	10
No.19	35	15.88	25	11.34	17	7.71	No. 19	8	10	15
No.20	25	11.34	20	9.07	13	5.90	No. 20	10	12	18

SPRINGS

ımerican Steel & Wire Company manufacture every variety, shape of Extension, Compression, Torsion and Flat Springs made from Steel n the following pages are illustrated a few of the most usual styles, by a list of the varieties and sizes regularly manufactured. Modifi- f these shapes and sizes can be made, when required in sufficient quan- special springs can be manufactured to order to meet special require- For further details, see special Spring Catalogue, which will be fur- ı request.

ering Springs, or requesting quotations, it is most important that ications should be clear and definite. Whenever possible, a SAMPLE is required SHOULD ACCOMPANY THE ORDER OR IN- but if this is not practicable, A SKETCH OF THE SPRING) BE SENT TO US, and the undermentioned particulars stated:





r Extension Springs:

of Wire—either the gauge (always stating what gauge :), or the exact diameter in of an inch or in millimeters.

le diameter of spring.

h of coil (see illustration).

h over all (see illustration).

of ends, and whether loops s, parallel or at right angles.

far spring is to be extended h what weight or power.

For Compression Springs:

Gauge of Wire—either the gauge number (always stating what gauge is meant), or the exact diameter in decimals of an inch or in millimeters.

Inside diameter if Spring works on a rod.

Outside diameter if Spring works in a hole.

Length.

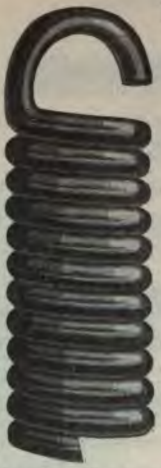
Pitch, or number of coils.

Ends—whether plain, squared, ground, or squared and ground.

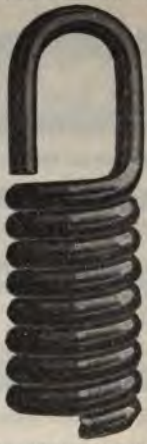
Distance to be compressed, and with what weight or power.

Always state size rod on which, or size hole in which, the Spring works.

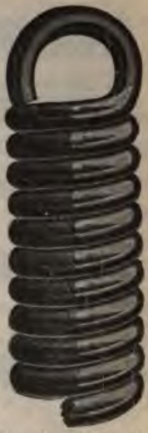
EXTENSION SPRINGS



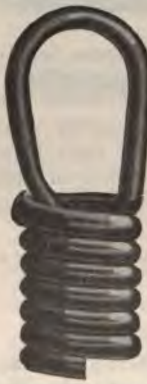
Showing Hook or Open End



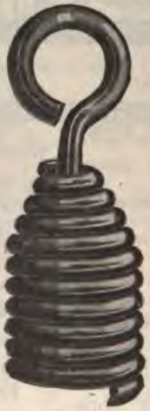
Showing End, with Long Open Loop or Hook



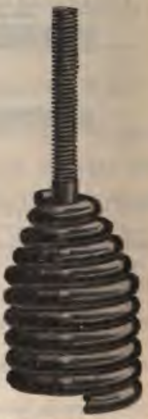
Showing Closed or Regular Loop



Showing Knotted or Forged Loop End



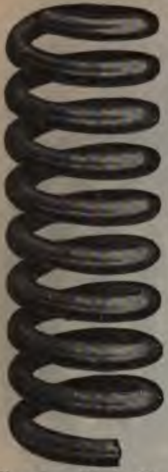
Showing Conical End, with Separate or Swivel Hook



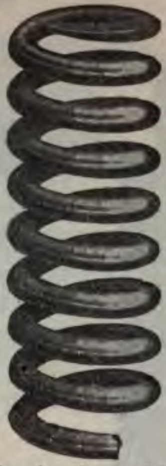
Showing Conical End, wi Separate Swivel Screw Bolt End

In ordering, always specify style of ends, and whether loops or hooks a parallel or at right angles.

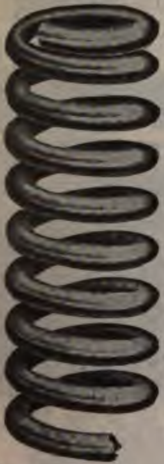
COMPRESSION SPRINGS



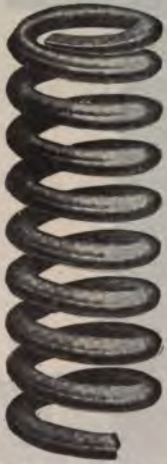
Showing Plain End



Showing Ground End



Showing End Squared

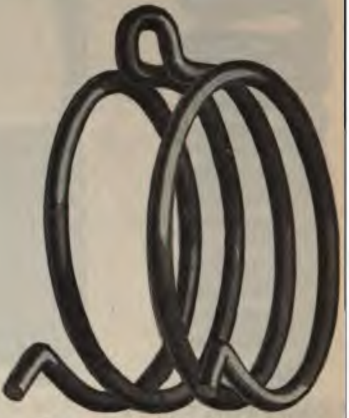


Showing End Squared and Ground

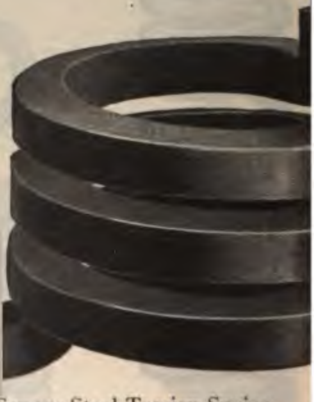
Never forget to state style of end when asking for prices. The end makes difference.

We can furnish extra heavy or extra light Compression Springs—for car ucks or the smallest novelties—to suit buyers' special requirements.

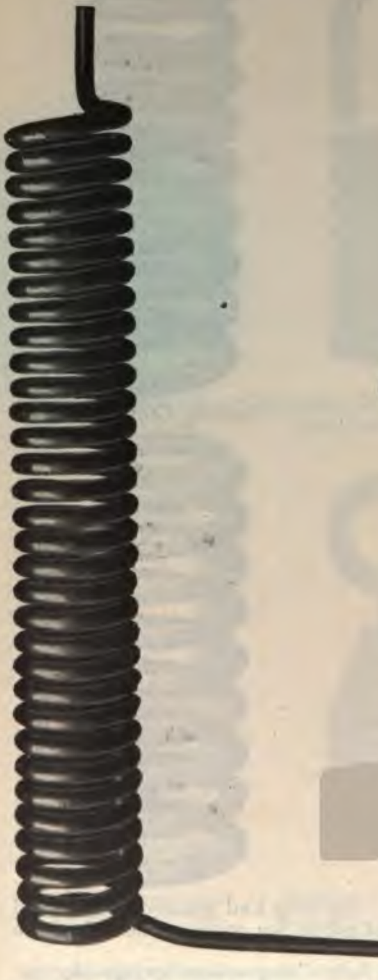
TORSION SPRINGS



Round Wire Torsion Spring



Square Steel Torsion Spring



Special Torsion Spring

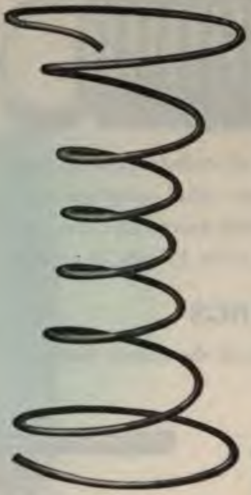
HELICAL SPRINGS

This term, while properly applicable to all coiled extension springs, has come, by trade usage, particularly to designate small coiled springs with loop ends, in use on spring beds. "Helicals," as thus known and illustrated above, are carried in stock—standard sizes, No. 10 to No. 13 wire, japanned in black.

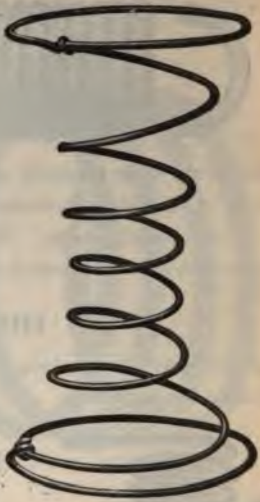
HINGE SPRINGS

Light or heavy gauge, long or short, made of the proper material to stand continuous torsion strain.

FURNITURE AND UPHOLSTERY SPRINGS



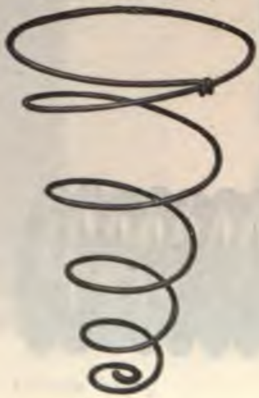
Plain End



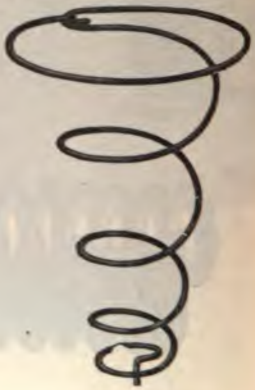
Knotted End

BED SPRINGS

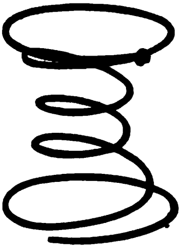
H. T. Bed Spring



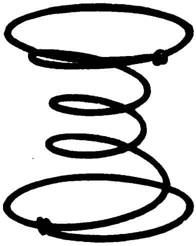
Solid Comfort Bed Spring



CUSHION SEAT SPRINGS

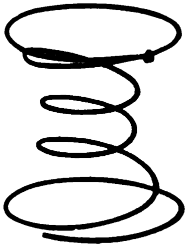


Knotted One End

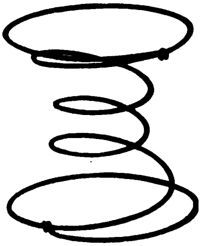


Knotted Both Ends

CUSHION BACK SPRINGS

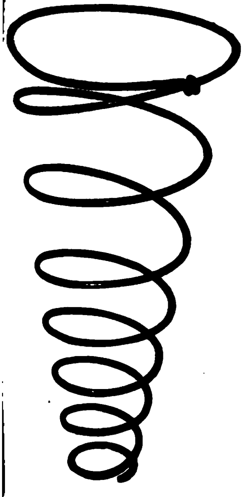


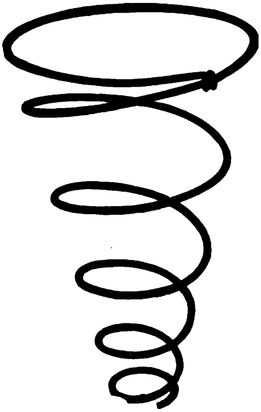
Knotted One End

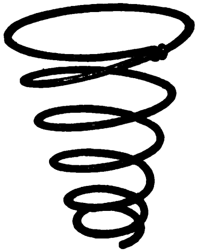


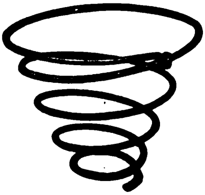
Knotted Both Ends

STAPLES AND HANFORD SPECIAL HALF SEAT SPRINGS









SPRINGS.—*Continued*

(See Special Spring Catalogue for further details)

FURNITURE AND UPHOLSTERY SPRINGS

Japanned or Coppered, Plain or Knotted Ends

No. 00— 3 inches high,	1½ center,	No. 11
No. 0— 4 inches high,	1½ center,	No. 11
No. 1— 6 inches high,	1¾ center,	No. 11
No. 2— 8 inches high,	1¾ center,	No. 10
No. 3— 9 inches high,	1¾ center,	No. 10
No. 4—10 inches high,	2 center,	No. 9½
No. 5—11 inches high,	2¼ center,	No. 9
No. 6—12 inches high,	2¼ center,	No. 9

Above are standard sizes and gauges. Any other size or gauge prom furnished.

Lounge Springs, plain or knotted, round, square, oblong and diamond.

Pillow Springs, regular sizes, 4, 5, 6 and 7 inches high of 12, 13, 14, 15 16 gauge; special sizes and gauges.

Bed Springs, 6½ inches high, 10½ and 11 gauge; specials.

Solid Comfort Bed Springs, Dowel point, plain, tight or Nelson knot, inches high, 12½ gauge; specials.

Dowel Springs, plain or knotted, eye or tip; any height and gauge.

Twin Bed Springs, Dowel point, tip or eye; any height and gauge.

Car Seat and Back Springs; any variety, height and gauge.

Cushion Seat Springs, 2½ inches high, 10 and 10½ gauge; specials.

Cushion Back Springs, 3 inches high, 14 and 15 gauge; specials.

Half Seat Springs, 2½ and 3 inches high, 10 and 10½ wire; specials.

Edge Springs; any desired shape.

Staples and Hanford, special springs for carriage, chair and couch w "Kangaroo" quality.

FLAT TEMPERED SPRINGS

(See Special Spring Catalogue)

Clock Springs, polished and colored, bronze or blue, ⅛ to 1 inch wide, to .018 inch thick, 20 inches to 9 feet in length, loop or marine ends, for al 1-day and 8-day clocks.

FLAT TEMPERED SPRINGS.—*Continued*

and Phonograph Springs, ¾ inch to 2 inches in width, .020 inch and 10 to 50 feet in length, black tempered, colored bronze or blue, punched nds, or special ends.

Roaster Springs.
lley Springs.
Springs.
ertising Springs.
Screen Springs.
hone Springs.
Springs.

Lamp Springs.
Typewriter Springs.
Toy Springs.
Time Lock Springs.
Music Box Springs.
Door Check Springs.
Sash Balance Springs.

Special Flat Springs of all descriptions.

SPIRAL AND MISCELLANEOUS SPRINGS

(See Special Spring Catalogue)

tion Door Springs, Nos. 1, 2, 3, 4, 5, 6 and 7, packed 12 in a box, ew hooks, black japanned finish.
e Saddle Springs to order, any style, nickel plated.
sion, Compression, Torsion, and Flat Springs for Agricultural Im-s; for mowers, reapers, binders, cultivators, rakes, stackers, planters, tedders, grain drills, harrows, plows; any style.
Springs, light or heavy, long or short.
gs for Wood-working Machinery.
Springs.
alve Springs, round or square steel.
Steel Springs for clothes wringers, baby carriages, car fenders, car etc.
sion Springs, all sizes and gauges.
ll Trolley Springs.
al Electric Trolley Springs.
l Springs, Nos. 10 to 13 wire, black japanned; special sizes.
n Springs, flat, round or square steel.
ruck Springs, any size, gauge or style.
h Springs.
r Springs.
y Boot Springs.
ie and Loom Springs.
Drill Tubes.
Springs.
gs of any kind, for any purpose.

SPECIAL SHAPED SPRINGS FOR AGRICULTURAL IMPLEMENTS

Rectangular Compression Springs and every kind of special shaped spring for agricultural machines and implements furnished in accordance with buyers' specifications, also Tedder Forks, Hay Loader and Hay Elevato Teeth of all styles and sizes.

TROLLEY SPRINGS

ral Electric Trolley
Spring

Nuttall Trolley Spring

rican Steel & Wire Company's Trolley Springs are used by all of al electric railway companies in the United States of America, and reign companies.

HEAVY STEEL SPRINGS

Buffer Spring

ELECTRIC STEEL

Illinois Steel Company manufactures a very superior quality of plain and special alloy steel, particularly suitable for the manufacture of obiles and special machinery, and for other purposes for which high steel is essential.

SPECIAL OPEN-HEARTH STEELS

Illinois and Carnegie Steel Companies also make Special Open-Hearth for particular uses, such as Shafting and Screw Stock, Buggy and Wagon Stock, Drop Forging Stock, Chain Steel, Fork Steel, Hoe Steel, Spade Steel, Hammer Stock, Special Automobile Steel, Welding Steel, etc., all ich have given entire satisfaction to a most critical trade. We shall be to receive inquiries for special qualities of steel to meet particular rements, which should state the fullest possible details in order that we be enabled to offer material of the most suitable quality.

ALLOY STEELS

e Carnegie Steel Company manufactures by both the open-hearth and lectric furnace processes various grades of Alloy Steels including Vana-, Chrome-Vanadium, Nickel, Nickel-Chrome and Chrome. The de-for Alloy Steels is rapidly increasing due to the tendency toward lighter tronger parts, especially in automobile and locomotive work, and the ability of this grade of material, when properly heat-treated, to meet service conditions.

s preferable that these Alloy Steels be ordered to the Carnegie Steel any's standard specifications for analysis, but special analyses will be careful consideration. Further particulars of the various grades with rd chemical ranges will be furnished upon request.

TENNESSEE SPECIAL TOOL STEEL

The Tennessee Coal, Iron and Railroad Company manufacture a straigh carbon tool steel for purposes not requiring a high speed steel. It is speciall suited for the following:

Mining Drills	Blacksmith Tools
Quarry Tools	Hammers and Sledges
Heading Dies	Stamps and Punches
Trimming Dies	Shear Knives
Air Hammer Tools	Hand Chisels

"Tennessee Special" is carried in stock in the following sizes:

ROUNDS: ⅜", ½", ⅝", ¾", ⅞", 1", 1⅛", 1¼", 1½", 1¾", 2", 2¼", 2½", 2¾", 3".

SQUARES: ⅜", ½", ⅝", ¾", ⅞", 1", 1⅛", 1¼", 1½", 1¾", 2", 2¼", 2½", 3", 3½".

OCTAGONS: ⅜", ½", ⅝", ¾", ⅞", 1", 1⅛", 1¼", 1½", 1¾", 2".

HEXAGONS: ⅞", 1".

SQUARE EDGE FLATS: 2½" x 1", 2½" x ¾", 2" x 1", 1½" x 1", 1½" x ¾", 1½" x ½", 1¼" x 1", 1" x ½".

CRUCIFORM BARS: 1", 1⅛", 1¼".

Other shapes and sizes will be considered.

SUGGESTIONS FOR HEATING, FORGING AND TEMPERING TENNESSEE SPECIAL TOOL STEEL

HEATING

Too much care cannot be exercised in heating "Tennessee Special Tool Steel." It should be heated uniformly through, and to get a uniform heat, you must first have a clean, bright fire; apply the blast slowly, turning STEEL in fire until it is heated well through, and then bring heat up quickly to a light cherry red or about 1400 to 1450° F. (760 to 788° C.) for forging.

FORGING

Forge at the above heat, being careful not to work the steel at too low a heat. When the steel has reduced to a dark red in color, reheat to finish forging, being careful to avoid reheating too often. When the forging is finished, heat th tool to a cherry red, and allow to cool in the air.

HEATING TO HARDEN

Heat the steel to full cherry red or 1425 to 1450° F. (774 to 788° C.), heatin slowly and uniformly through, avoiding bringing the corners and sharp edg to a higher heat than the body of the tool, and by no means allow the tool t soak in the fire after it has been heated to the proper temperature. Quenc in water or a good quality of fish oil. If quenched in water, the water should heated to 90 to 100° F. (32.2 to 37.8° C.), and steel kept in motion while bei quenched, to avoid water checks.

NOTE.—Tennessee Special Tool Steel should have temper drawn at a high temperature than most Carbon Tool Steels.

BAMBOO STEEL

This product is extensively used in China, Japan, the Philippine Islands and the Dutch East Indies for a large variety of purposes, including the making of wood-working tools, razors, harvesting knives for hemp, tobacco, sugar cane, etc., and other implements. It is usually furnished in the following sizes:

Round and square bars: 3/8″ to 2½″ inclusive.

Flat Bars, with either round or square edges: 1″ x ¼″, 1¼″ x ¼″, 1⅛″ x 5/16″, 1¾″ x 5/16″, 1⅜″ x ⅜″, 1½″ x ⅜″, 1¾″ x ⅜″.

Other sizes may, however, be submitted for our consideration.

In ordering Flat Bamboo Steel with round edges, state whether the width mentioned is measured over all or on the flat.

Our Bamboo Steel consists of plain smooth bars, without any lugs or corrugations.

It is usually furnished in strong wooden boxes made of wood 1″ thick securely strapped to withstand the handling incidental to ocean shipment, containing 133⅓ lbs. (1 picul), 80 lbs., 72 lbs. or 70 lbs., net weight, but boxes of other weights can be furnished if desired.

MERCHANT BARS

We furnish Bars of various qualities, suitable for general and uses, of the shapes and range of sizes shown on the following pag "CARNEGIE X" Bars are well and favorably known in most of the markets of the world and, by reason of their excellent working-up q are particularly suitable for general blacksmiths' work, giving better with less expenditure of labor and fuel, than many of the higher price of iron.

Inquiries and orders for bars required for special purposes should specify the requirements fully and clearly, in order that the most quality may be furnished. For making bolts, our special "Besse Steel" should be specified.

SQUARES

WIDTH ACROSS FACES

$\frac{3}{16}$″ to 2″ inclusive, advancing by 64ths. (4.763 to 50.80 m/m, ing by 0.397 m/m.)

2$\frac{1}{32}$″ to 3½″ inclusive, advancing by 32nds. (51.60 to 88.90 m/m, ing by 0.794 m/m.)

3$\frac{9}{16}$″ to 5½″ inclusive, advancing by 16ths. (90.49 to 139.70 m/m, ing by 1.588 m/m.)

Squares can also be rolled to dimensions in decimals of an inch if so ar Squares ⅞″ (22.23 m/m) and smaller can be furnished in coils.

For tables of weights, see page 141.

ROUND CORNERED SQUARES

WIDTH ACROSS FACES

¼″ to ¾″ inclusive, advancing by 64ths. (6.35 to 19.05 m/m, ad by 0.397 m/m.)

Weights approximately the same as weights of Squares of corres sizes.

ROUNDS

DIAMETER

$\frac{7}{32}$″ to 1¾″ inclusive, advancing by 64ths. (5.565 to 44.45 m/m, ing by 0.397 m/m.)

1$\frac{25}{32}$″ to 3½″ inclusive, advancing by 32nds. (45.24 to 88.90 m/m, ing by 0.794 m/m.)

3$\frac{9}{16}$″ to 7″ inclusive, advancing by 16ths. (90.49 to 177.80 m/m, ing by 1.588 m/m.)

Rounds can also be rolled to dimensions in decimals of an inch, i ranged. Rounds ⅞″ (22.23 m/m) and smaller can be furnished in coils.

For tables of weights, see page 142.

Merchant Bars.—*Continued*

HALF ROUNDS

DIAMETER

5/16" to ⅞" inclusive, advancing by 64ths. (7.938 to 22.23 m/m, advanc- g by 0.397 m/m.)

15/16" to 1¾" inclusive, advancing by 16ths. (23.81 to 44.45 m/m, advanc- ng by 1.588 m/m.)

2", 2½", 3". (50.80, 63.50 and 76.20 m/m.)

Weights equal one-half of weight of Rounds of corresponding diameters.

HEXAGONS

WIDTH ACROSS FACES

¼" to 1 11/16" inclusive, advancing by 32nds. (6.35 to 42.86 m/m, advancing by 0.794 m/m.)

1¾" to 3 1/16" inclusive, advancing by 16ths. (44.45 to 77.79 m/m, advancing by 1.59 m/m.)

3 3/16". (80.96 m/m.)

For tables of weights, see page 145.

OCTAGONS

WIDTH ACROSS FACES

¼" to 2" inclusive, advancing by 32nds. (6.35 to 50.80 m/m, advancing by 0.794 m/m.)

For tables of weights, see page 145.

SQUARE EDGE FLATS

⅜" to 3" (9.525 to 76.20 m/m) wide, by any thickness ⅛" (3.175 m/m) up to width.

Over 3" to 5" (76.20 to 127 m/m) wide, by any thickness ¼" to 3" (6.35 to 76.20 m/m) inclusive.

Over 5" to 7" (127 to 177.80 m/m) wide, by any thickness ¼" to 2" (6.35 to 50.80 m/m) inclusive.

Sizes not listed will be considered, if in quantities sufficient for special rolling.

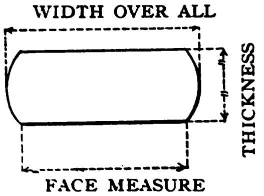
For tables of weights, see pages 143 and 144.

BAND EDGE FLATS

For range of sizes, see table of sizes of Hoops and Bands, page 174. For table of weights, see page 175.

MERCHANT BARS.—*Continued*

ROUND EDGE FLATS, INCLUDING ROUND EDGE TIRE



3/8" to 7/16" (9.525 to 11.11 m/m) x No. 12 B. W. G. to 1/4" (2.77 to 6.35 m/m)-
Face measure only.

1/2" to 9/16" (12.70 to 14.29 m/m) x No. 12 B. W. G. to 5/16" (2.77 to 7.94 m/m)-
Face or over-all measure.

5/8" to 11/16" (15.88 to 17.46 m/m) x No. 12 B. W. G. to 3/8" (2.77 to 9.53 m/m)-
Face or over-all measure.

3/4" to 13/16" (19.05 to 20.64 m/m) x No. 12 B.W.G. to 1/2" (2.77 to 12.70 m/m)-
Face or over-all measure.

7/8" to 1 7/16" (22.23 to 36.51 m/m) x No. 12 B. W. G. to 3/4" (2.77 to 19.05 m/m). Face or over-all measure.

1 1/2" to 2" (38.10 to 50.80 m/m) x No. 12 B. W. G. to 1" (2.77 to 25.40 m/m)-
Face or over-all measure.

2 1/8" to 3" (53.98 to 76.20 m/m) x 1/8" to 1 1/16" (3.175 to 26.99 m/m).
Face or over-all measure.

3 1/8" to 4" (79.38 to 101.60 m/m) x 1/4" to 1 1/16" (6.35 to 26.99 m/m).
Face or over-all measure.

4 1/8" to 6" (104.78 to 152.40 m/m) x 5/16" to 1" (7.94 to 25.40 m/m).
Face or over-all measure.

6" to 6 11/16" (152.40 to 169.86 m/m) x 1/4" to 1/2" (6.35 to 12.70 m/m).
Face or over-all measure.

6 3/4" to 7" (171.45 to 177.80 m/m) x 1/4" to 1/2" (6.35 to 12.70 m/m).
Over-all measure only.

The over-all measure is determined by adding to face measure:

One half of the thickness for all sizes up to 1/2" (12.7 m/m), inclusive, in thickness.

5/16" (7.94 m/m) for all sizes over 1/2" to 3/4" (12.7 to 19.05 m/m), inclusive, in thickness.

3/8" (9.53 m/m) for all sizes over 3/4" (19.05 m/m) in thickness.

Sizes not listed, and other roundings, will be considered if in quantities sufficient for special rolling.

WEIGHTS OF SQUARE BARS

ze, ch	Pounds per Foot	Kilos per Meter
3/16	.1195	.178
13/64	.1403	.209
7/32	.1627	.242
15/64	.1868	.278
1/4	.2125	.316
17/64	.2399	.357
9/32	.2689	.400
19/64	.2997	.446
5/16	.3320	.494
21/64	.3661	.545
11/32	.4018	.598
23/64	.4391	.653
3/8	.4781	.711
25/64	.5188	.772
13/32	.5611	.835
27/64	.6051	.900
7/16	.6508	.969
29/64	.6981	1.039
15/32	.7471	1.112
31/64	.7977	1.187
1/2	.8500	1.265
33/64	.9040	1.345
17/32	.9596	1.428
35/64	1.0168	1.513
9/16	1.0758	1.601
37/64	1.1364	1.691
19/32	1.1986	1.784
39/64	1.2625	1.879
5/8	1.3281	1.977
41/64	1.3954	2.077
21/32	1.4643	2.179
43/64	1.5348	2.284
11/16	1.6070	2.392
45/64	1.6809	2.501
23/32	1.7564	2.614
47/64	1.8336	2.729
3/4	1.9125	2.846
49/64	1.9930	2.966
25/32	2.0752	3.088
51/64	2.1590	3.213
13/16	2.2445	3.340
53/64	2.3317	3.470
27/32	2.4205	3.602
55/64	2.5110	3.737
7/8	2.6031	3.874
57/64	2.6969	4.013
29/32	2.7924	4.156
59/64	2.8895	4.300
15/16	2.9883	4.447
61/64	3.0887	4.597
31/32	3.1908	4.748
63/64	3.2946	4.903
1	3.4000	5.060

Size, Inches	Pounds per Foot	Kilos per Meter
1 1/32	3.616	5.381
1 1/16	3.838	5.712
1 3/32	4.067	6.052
1 1/8	4.303	6.404
1 5/32	4.546	6.765
1 3/16	4.795	7.136
1 7/32	5.050	7.515
1 1/4	5.313	7.907
1 9/32	5.581	8.306
1 5/16	5.857	8.716
1 11/32	6.139	9.136
1 3/8	6.428	9.566
1 13/32	6.724	10.007
1 7/16	7.026	10.456
1 15/32	7.335	10.916
1 1/2	7.650	11.385
1 17/32	7.972	11.864
1 9/16	8.301	12.352
1 19/32	8.636	12.852
1 5/8	8.978	13.361
1 21/32	9.327	13.880
1 11/16	9.682	14.409
1 23/32	10.044	14.947
1 3/4	10.413	15.497
1 25/32	10.788	16.055
1 13/16	11.170	16.623
1 27/32	11.558	17.200
1 7/8	11.953	17.788
1 29/32	12.355	18.386
1 15/16	12.763	18.993
1 31/32	13.178	19.612
2	13.600	20.239
2 1/32	14.028	20.877
2 1/16	14.463	21.524
2 3/32	14.905	22.181
2 1/8	15.353	22.848
2 5/32	15.808	23.525
2 3/16	16.270	24.212
2 7/32	16.738	24.909
2 1/4	17.213	25.616
2 9/32	17.694	26.332
2 5/16	18.182	27.058
2 11/32	18.677	27.795
2 3/8	19.178	28.541
2 13/32	19.686	29.297
2 7/16	20.201	30.063
2 15/32	20.722	30.838
2 1/2	21.250	31.624
2 17/32	21.785	32.420
2 9/16	22.326	33.225
2 19/32	22.874	34.041
2 5/8	23.428	34.866
2 21/32	23.989	35.701
2 11/16	24.557	36.546
2 23/32	25.131	37.400
2 3/4	25.713	38.265

Size, Inches	Pounds per Foot	Kilos per Meter
2 25/32	26.300	39.139
2 13/16	26.895	40.024
2 27/32	27.496	40.918
2 7/8	28.103	41.822
2 29/32	28.717	42.736
2 15/16	29.338	43.661
2 31/32	29.966	44.595
3	30.600	45.538
3 1/32	31.241	46.492
3 1/16	31.888	47.455
3 3/32	32.542	48.428
3 1/8	33.203	49.412
3 5/32	33.871	50.406
3 3/16	34.545	51.409
3 7/32	35.225	52.421
3 1/4	35.913	53.444
3 9/32	36.606	54.476
3 5/16	37.307	55.519
3 11/32	38.014	56.571
3 3/8	38.728	57.633
3 13/32	39.449	58.706
3 7/16	40.176	59.789
3 15/32	40.910	60.881
3 1/2	41.650	61.982
3 9/16	43.151	64.216
3 5/8	44.678	66.489
3 11/16	46.232	68.801
3 3/4	47.813	71.153
3 13/16	49.420	73.545
3 7/8	51.053	75.976
3 15/16	52.713	78.446
4	54.400	80.956
4 1/16	56.113	83.506
4 1/8	57.853	86.096
4 3/16	59.620	88.726
4 1/4	61.413	91.394
4 5/16	63.232	94.101
4 3/8	65.078	96.848
4 7/16	66.951	99.635
4 1/2	68.850	102.461
4 9/16	70.776	105.327
4 5/8	72.728	108.231
4 11/16	74.707	111.177
4 3/4	76.713	114.162
4 13/16	78.745	117.186
4 7/8	80.803	120.249
4 15/16	82.888	123.351
5	85.000	126.494
5 1/16	87.138	129.676
5 1/8	89.303	132.899
5 3/16	91.495	136.161
5 1/4	93.713	139.462
5 5/16	95.957	142.801
5 3/8	98.228	146.180
5 7/16	100.526	149.600
5 1/2	102.850	153.059

WEIGHTS OF ROUND BARS

Size, Inch	Pounds per Foot	Kilos per Meter	Size, Inches	Pounds per Foot	Kilos per Meter	Size, Inches	Pounds per Foot
7/32	.1278	.190	1 5/32	3.5700	5.313	2 29/32	22.555
15/64	.1467	.218	1 3/16	3.7656	5.604	2 15/16	23.042
1/4	.1669	.248	1 7/32	3.9664	5.903	2 31/32	23.535
17/64	.1884	.280	1 1/4	4.1724	6.209	3	24.033
9/32	.2112	.314	1 9/32	4.3836	6.524	3 1/32	24.537
19/64	.2354	.350	1 5/16	4.6001	6.846	3 1/16	25.045
5/16	.2608	.388	1 11/32	4.8218	7.176	3 3/32	25.559
21/64	.2875	.428	1 3/8	5.0486	7.513	3 1/8	26.078
11/32	.3155	.470	1 13/32	5.2807	7.859	3 5/32	26.602
23/64	.3449	.513	1 7/16	5.5180	8.212	3 3/16	27.131
3/8	.3755	.559	1 15/32	5.7606	8.573	3 7/32	27.666
25/64	.4075	.606	1 1/2	6.0083	8.941	3 1/4	28.206
13/32	.4407	.656	1 17/32	6.2613	9.318	3 9/32	28.751
27/64	.4753	.707	1 9/16	6.5194	9.702	3 5/16	29.301
7/16	.5111	.759	1 19/32	6.7828	10.094	3 11/32	29.856
29/64	.5483	.816	1 5/8	7.0514	10.494	3 3/8	30.417
15/32	.5867	.873	1 21/32	7.3252	10.901	3 13/32	30.983
31/64	.6265	.932	1 11/16	7.6043	11.316	3 7/16	31.554
1/2	.6676	.994	1 23/32	7.8885	11.739	3 15/32	32.130
33/64	.7100	1.057	1 3/4	8.1780	12.170	3 1/2	32.712
17/32	.7536	1.121	1 25/32	8.4727	12.609	3 9/16	33.891
35/64	.7986	1.188	1 13/16	8.7725	13.055	3 5/8	35.090
9/16	.8449	1.257	1 27/32	9.0777	13.509	3 11/16	36.311
37/64	.8925	1.328	1 7/8	9.3880	13.971	3 3/4	37.552
19/32	.9414	1.401	1 29/32	9.7035	14.441	3 13/16	38.814
39/64	.9916	1.476	1 15/16	10.0243	14.918	3 7/8	40.097
5/8	1.0431	1.552	1 31/32	10.3503	15.403	3 15/16	41.401
41/64	1.0959	1.631	2	10.6814	15.896	4	42.726
21/32	1.1500	1.711	2 1/32	11.0178	16.397	4 1/16	44.071
43/64	1.2054	1.794	2 1/16	11.3595	16.905	4 1/8	45.438
11/16	1.2622	1.878	2 3/32	11.7063	17.421	4 3/16	46.825
45/64	1.3202	1.965	2 1/8	12.0583	17.945	4 1/4	48.233
23/32	1.3795	2.053	2 5/32	12.4156	18.476	4 5/16	49.662
47/64	1.4401	2.143	2 3/16	12.7781	19.016	4 3/8	51.112
3/4	1.5021	2.235	2 7/32	13.1458	19.564	4 7/16	52.583
49/64	1.5653	2.329	2 1/4	13.5187	20.119	4 1/2	54.075
25/32	1.6299	2.426	2 9/32	13.8968	20.682	4 9/16	55.587
51/64	1.6957	2.524	2 5/16	14.2802	21.252	4 5/8	57.121
13/16	1.7629	2.624	2 11/32	14.6687	21.830	4 11/16	58.675
53/64	1.8313	2.725	2 3/8	15.0625	22.416	4 3/4	60.250
27/32	1.9011	2.829	2 13/32	15.4615	23.010	4 13/16	61.846
55/64	1.9721	2.935	2 7/16	15.8657	23.611	4 7/8	63.463
7/8	2.0445	3.043	2 15/32	16.2751	24.220	4 15/16	65.100
57/64	2.1182	3.152	2 1/2	16.6898	24.838	5	66.759
29/32	2.1931	3.264	2 17/32	17.1096	25.462	5 1/16	68.438
59/64	2.2694	3.377	2 9/16	17.5347	26.095	5 1/8	70.139
15/16	2.3470	3.493	2 19/32	17.9650	26.735	5 3/16	71.860
			2 5/8	18.4004	27.383	5 1/4	73.602
61/64	2.4259	3.610	2 21/32	18.8412	28.039	5 5/16	75.365
31/32	2.5061	3.730	2 11/16	19.2871	28.703	5 3/8	77.148
63/64	2.5876	3.851	2 23/32	19.7382	29.375	5 7/16	78.953
1	2.6704	3.974	2 3/4	20.1946	30.054	5 1/2	80.778
1 1/32	2.8399	4.226	2 25/32	20.656	30.740	5 9/16	82.625
1 1/16	3.0146	4.486	2 13/16	21.123	31.435	5 5/8	84.492
	3.1945	4.754	2 27/32	21.595	32.137	5 11/16	86.380
	3.3797	5.030	2 7/8	22.072	32.847	5 3/4	88.289

WEIGHTS OF ROUND BARS.—*Continued*

Size, Inches	Pounds per Foot	Kilos per Meter	Size, Inches	Pounds per Foot	Kilos per Meter	Size, Inches	Pounds per Foot	Kilos per Meter
5 13/16	90.22	134.263	6 9/16	106.41	158.358	6 13/16	123.93	184.430
5⅞	92.17	137.165	6⅝	108.53	161.513	6⅞	126.22	187.839
5 15/16	94.14	140.097	6 11/16	110.66	164.682	6 15/16	128.52	191.262
6	96.13	143.058	6¾	112.82	167.896	7	130.85	194.729
6 1/16	98.15	146.064	6 9/16	115.00	171.140	.....	....	....
6⅛	100.18	149.088	6⅝	117.20	174.415	.....	....	....
6 3/16	102.24	152.151	6 11/16	119.43	177.734	.....	....	....
6¼	104.31	155.231	6¾	121.67	181.067	.....	....	....

WEIGHTS OF FLAT BARS

Size, Inches	Pounds per Foot	Kilos per Meter	Size, Inches	Pounds per Foot	Kilos per Meter	Size, Inches	Pounds per Foot	Kilos per Meter
⅜ x ⅛	.1594	.2372	1¾ x ⅛	.744	1.107	2½ x 2	17.000	25.299
⅜ x ¼	.3188	.4744	1¾ x ¼	1.488	2.214	2½ x 2¼	19.125	28.462
½ x ⅛	.2125	.3163	1¾ x ⅜	2.231	3.321	2¾ x ⅛	1.169	1.739
½ x ¼	.4250	.6325	1¾ x ½	2.975	4.427	2¾ x ¼	2.338	3.479
½ x ⅜	.6375	.9487	1¾ x ⅝	3.719	5.535	2¾ x ⅜	3.506	5.218
⅝ x ⅛	.2656	.3953	1¾ x ¾	4.463	6.641	2¾ x ½	4.675	6.957
⅝ x ¼	.5313	.7906	1¾ x ⅞	5.206	7.748	2¾ x ⅝	5.844	8.697
⅝ x ⅜	.7969	1.1859	1¾ x 1	5.950	8.855	2¾ x ¾	7.013	10.436
⅝ x ½	1.0625	1.5812	1¾ x 1¼	7.438	11.069	2¾ x ⅞	8.181	12.175
¾ x ⅛	.3188	.4744	1¾ x 1½	8.925	13.282	2¾ x 1	9.350	13.915
¾ x ¼	.6375	.9487	2 x ⅛	.850	1.265	2¾ x 1¼	11.688	17.393
¾ x ⅜	.9563	1.4231	2 x ¼	1.700	2.530	2¾ x 1½	14.025	20.872
¾ x ½	1.2750	1.8975	2 x ⅜	2.550	3.795	2¾ x 1¾	16.363	24.350
¾ x ⅝	1.5938	2.3719	2 x ½	3.400	5.060	2¾ x 2	18.700	27.829
⅞ x ⅛	.3719	.5534	2 x ⅝	4.250	6.325	2¾ x 2¼	21.038	31.308
⅞ x ¼	.7438	1.1068	2 x ¾	5.100	7.590	2¾ x 2½	23.375	34.786
⅞ x ⅜	1.1156	1.6603	2 x ⅞	5.950	8.855	3 x ⅛	1.275	1.897
⅞ x ½	1.4875	2.2137	2 x 1	6.800	10.120	3 x ¼	2.550	3.795
⅞ x ⅝	1.8594	2.7671	2 x 1¼	8.500	12.650	3 x ⅜	3.825	5.692
⅞ x ¾	2.2313	3.3205	2 x 1½	10.200	15.180	3 x ½	5.100	7.590
1 x ⅛	.4250	.6325	2 x 1¾	11.900	17.709	3 x ⅝	6.375	9.487
1 x ¼	.8500	1.2650	2¼ x ⅛	.956	1.423	3 x ¾	7.650	11.385
1 x ⅜	1.2750	1.8975	2¼ x ¼	1.913	2.846	3 x ⅞	8.925	13.282
1 x ½	1.7000	2.5300	2¼ x ⅜	2.869	4.269	3 x 1	10.200	15.180
1 x ⅝	2.1250	3.1625	2¼ x ½	3.825	5.692	3 x 1¼	12.750	18.974
1 x ¾	2.5500	3.7949	2¼ x ⅝	4.781	7.115	3 x 1½	15.300	22.769
1 x ⅞	2.9750	4.4275	2¼ x ¾	5.738	8.539	3 x 1¾	17.850	26.564
1¼ x ⅛	.5313	.7906	2¼ x ⅞	6.694	9.962	3 x 2	20.400	30.359
1¼ x ¼	1.0625	1.5812	2¼ x 1	7.650	11.385	3 x 2¼	22.950	34.154
1¼ x ⅜	1.5938	2.3718	2¼ x 1¼	9.563	14.231	3 x 2½	25.500	37.949
1¼ x ½	2.1250	3.1624	2¼ x 1½	11.475	17.077	3 x 2¾	28.050	41.743
1¼ x ⅝	2.6563	3.9530	2¼ x 1¾	13.388	19.923	3¼ x ¼	2.763	4.111
1¼ x ¾	3.1875	4.7435	2¼ x 2	15.300	22.769	3¼ x ⅜	4.144	6.167
1¼ x ⅞	3.7188	5.5342	2½ x ⅛	1.063	1.581	3¼ x ½	5.525	8.222
1¼ x 1	4.2500	6.3248	2½ x ¼	2.125	3.162	3¼ x ⅝	6.906	10.278
1½ x ⅛	.6375	.9487	2½ x ⅜	3.188	4.744	3¼ x ¾	8.288	12.333
1½ x ¼	1.2750	1.8974	2½ x ½	4.250	6.325	3¼ x ⅞	9.669	14.389
1½ x ⅜	1.9125	2.8461	2½ x ⅝	5.313	7.906	3¼ x 1	11.050	16.444
1½ x ½	2.5500	3.7949	2½ x ¾	6.375	9.487	3¼ x 1¼	13.813	20.556
1½ x ⅝	3.1875	4.7435	2½ x ⅞	7.438	11.069	3¼ x 1½	16.675	24.667
1½ x ¾	3.8250	5.6922	2½ x 1	8.500	12.650	3¼ x 1¾	19.338	28.778
1½ x ⅞	4.4625	6.6410	2½ x 1¼	10.625	15.812	3¼ x 2	22.100	32.889
1½ x 1	5.1000	7.5897	2½ x 1½	12.750	18.975	3¼ x 2¼	24.863	37.000
1½ x 1¼	6.3750	9.4871	2½ x 1¾	14.875	22.137	3¼ x 2½	27.625	41.111

WEIGHTS OF FLAT BARS.—*Continued*

Size, Inches	Pounds per Foot	Kilos per Meter	Size, Inches	Pounds per Foot	Kilos per Meter	Size, Inches	Pounds per Foot
3¼ x 2¾	30.388	45.222	4 x 1¾	23.800	35.419	5½ x ¾	14.025
3¼ x 3	33.150	49.333	4 x 2	27.200	40.479	5½ x ⅞	16.363
3½ x ¼	2.975	4.427	4 x 2¼	30.600	45.539	5½ x 1	18.700
3½ x ⅜	4.463	6.641	4 x 2½	34.000	50.598	5½ x 1¼	23.375
3½ x ½	5.950	8.855	4 x 2¾	37.400	55.658	5½ x 1½	28.050
3½ x ⅝	7.438	11.068	4 x 3	40.800	60.717	5½ x 1¾	32.725
3½ x ¾	8.925	13.282	4½ x ¼	3.825	5.692	5½ x 2	37.400
3½ x ⅞	10.413	15.496	4½ x ⅜	5.738	8.539	6 x ¼	5.100
3½ x 1	11.900	17.710	4½ x ½	7.650	11.385	6 x ⅜	7.650
3½ x 1¼	14.875	22.137	4½ x ⅝	9.563	14.231	6 x ½	10.200
3½ x 1½	17.850	26.564	4½ x ¾	11.475	17.077	6 x ⅝	12.750
3½ x 1¾	20.825	30.992	4½ x ⅞	13.388	19.923	6 x ¾	15.300
3½ x 2	23.800	35.419	4½ x 1	15.300	22.769	6 x ⅞	17.850
3½ x 2¼	26.775	39.847	4½ x 1¼	19.125	28.462	6 x 1	20.400
3½ x 2½	29.750	44.274	4½ x 1½	22.950	34.154	6 x 1¼	25.500
3½ x 2¾	32.725	48.701	4½ x 1¾	26.775	39.846	6 x 1½	30.600
3½ x 3	35.700	53.128	4½ x 2	30.600	45.538	6 x 1¾	35.700
3¾ x ¼	3.188	4.744	4½ x 2¼	34.425	51.230	6 x 2	40.800
3¾ x ⅜	4.781	7.115	4½ x 2½	38.250	56.922	6½ x ¼	5.525
3¾ x ½	6.375	9.487	4½ x 2¾	42.075	62.615	6½ x ⅜	8.288
3¾ x ⅝	7.969	11.859	4½ x 3	45.900	68.307	6½ x ½	11.050
3¾ x ¾	9.563	14.230	5 x ¼	4.250	6.325	6½ x ⅝	13.813
3¾ x ⅞	11.156	16.602	5 x ⅜	6.375	9.488	6½ x ¾	16.575
3¾ x 1	12.750	18.974	5 x ½	8.500	12.650	6½ x ⅞	19.338
3¾ x 1¼	15.938	23.718	5 x ⅝	10.625	15.813	6½ x 1	22.100
3¾ x 1½	19.125	28.462	5 x ¾	12.750	18.975	6½ x 1¼	27.625
3¾ x 1¾	22.313	33.205	5 x ⅞	14.875	22.137	6½ x 1½	33.150
3¾ x 2	25.500	37.949	5 x 1	17.000	25.299	6½ x 1¾	38.675
3¾ x 2¼	28.688	42.692	5 x 1¼	21.250	31.624	6½ x 2	44.200
3¾ x 2½	31.875	47.435	5 x 1½	25.500	37.949	7 x ¼	5.950
3¾ x 2¾	35.063	52.179	5 x 1¾	29.750	44.274	7 x ⅜	8.925
3¾ x 3	38.250	56.922	5 x 2	34.000	50.598	7 x ½	11.900
4 x ¼	3.400	5.060	5 x 2¼	38.250	56.923	7 x ⅝	14.875
4 x ⅜	5.100	7.590	5 x 2½	42.500	63.248	7 x ¾	17.850
4 x ½	6.800	10.120	5 x 2¾	46.750	69.572	7 x ⅞	20.825
4 x ⅝	8.500	12.650	5 x 3	51.000	75.897	7 x 1	23.800
4 x ¾	10.200	15.180	5½ x ¼	4.675	6.957	7 x 1¼	29.750
4 x ⅞	11.900	17.710	5½ x ⅜	7.013	10.436	7 x 1½	35.700
4 x 1	13.600	20.240	5½ x ½	9.350	13.915	7 x 1¾	41.650
4 x 1¼	17.000	25.299	5½ x ⅝	11.688	17.393	7 x 2	47.600
4 x 1½	20.400	30.359					

To ascertain the weight of sizes of flat bars not included in the above table, multi width in inches by the thickness in inches, and the resulting product by 3.4 for pounds or by 5.06 for kilos per meter. Example: 4″ x 1⅛″ bars; 4 x 1⅛ x 3.4 — 15.3 lbs. p and 4 x 1⅛ x 5.06 — 22.77 kilos per meter.

WEIGHTS OF HEXAGON BARS

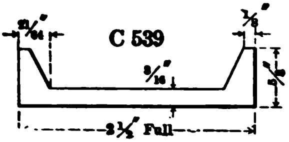
Size, Inches	Pounds per Foot	Kilos per Meter	Size, Inches	Pounds per Foot	Kilos per Meter	Size, Inches	Pounds per Foot	Kilos per Meter
1/4	.1840	.2738	1 3/32	3.522	5.241	2 5/16	15.746	23.433
			1 1/8	3.727	5.546	2 3/8	16.609	24.717
9/32	.2329	.3466				2 7/16	17.494	26.034
5/16	.2875	.4279	1 5/32	3.937	5.859	2 1/2	18.403	27.387
11/32	.3479	.5177	1 3/16	4.152	6.179			
3/8	.4141	.6163	1 7/32	4.374	6.509	2 9/16	19.335	28.775
			1 1/4	4.601	6.847	2 5/8	20.289	30.194
13/32	.4860	.7233				2 11/16	21.267	31.649
7/16	.5636	.8387	1 9/32	4.834	7.194	2 3/4	22.268	33.139
15/32	.6470	.9629	1 5/16	5.072	7.548			
1/2	.7361	1.0954	1 11/32	5.317	7.913	2 13/16	23.291	34.662
			1 3/8	5.567	8.285	2 7/8	24.338	36.220
17/32	.8310	1.2367				2 15/16	25.408	37.812
9/16	.9316	1.3864	1 13/32	5.823	8.666	3	26.500	39.437
19/32	1.0380	1.5448	1 7/16	6.085	9.056			
5/8	1.1502	1.7117	1 15/32	6.352	9.453	3 1/16	27.616	41.098
			1 1/2	6.625	9.859	3 1/8	28.755	42.793
21/32	1.2681	1.8872				3 3/16	29.916	44.521
11/16	1.3917	2.0712	1 9/16	7.189	10.698	3 1/4	31.101	46.283
23/32	1.5211	2.2637	1 5/8	7.775	11.571			
3/4	1.6563	2.4649	1 11/16	8.385	12.478	3 5/16	32.309	48.081
			1 3/4	9.018	13.420	3 3/8	33.540	49.914
25/32	1.7972	2.6746				3 7/16	34.793	51.778
13/16	1.9438	2.8928	1 13/16	9.673	14.395	3 1/2	36.070	53.678
27/32	2.0962	3.1196	1 7/8	10.352	15.406			
7/8	2.2544	3.3549	1 15/16	11.053	16.449	3 9/16	37.370	55.613
			2	11.778	17.528	3 5/8	38.692	57.580
29/32	2.4183	3.5989				3 11/16	40.038	59.584
15/16	2.5879	3.8513	2 1/16	12.525	18.639	3 3/4	41.407	61.621
31/32	2.7633	4.1123	2 1/8	13.296	19.788			
1	2.9445	4.3820	2 3/16	14.089	20.967	3 13/16	42.799	63.692
			2 1/4	14.907	22.185	3 7/8	44.213	65.797
1 1/32	3.131	4.659				3 15/16	45.651	67.937
1 1/16	3.324	4.947				4	47.112	70.111

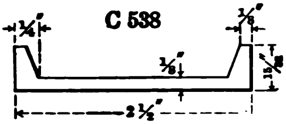
WEIGHTS OF OCTAGON BARS

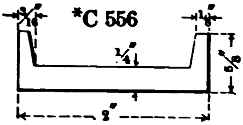
Size, Inches	Pounds per Foot	Kilos per Meter	Size, Inches	Pounds per Foot	Kilos per Meter	Size, Inches	Pounds per Foot	Kilos per Meter
1/4	.1760	.262	27/32	2.0052	2.984	1 7/16	5.820	8.661
9/32	.2228	.332	7/8	2.1565	3.209	1 15/32	6.076	9.042
5/16	.2751	.409	29/32	2.3133	3.443	1 1/2	6.337	9.431
11/32	.3328	.495	15/16	2.4756	3.684	1 17/32	6.604	9.828
3/8	.3961	.589	31/32	2.6434	3.934	1 9/16	6.877	10.234
13/32	.4649	.692	1	2.8167	4.192	1 19/32	7.154	10.646
7/16	.5391	.802	1 1/32	2.995	4.457	1 5/8	7.438	11.069
15/32	.6189	.921	1 1/16	3.180	4.732	1 21/32	7.727	11.499
1/2	.7042	1.048	1 3/32	3.370	5.015	1 11/16	8.021	11.937
17/32	.7949	1.183	1 1/8	3.565	5.305	1 23/32	8.321	12.383
9/16	.8912	1.326	1 5/32	3.766	5.604	1 3/4	8.626	12.837
19/32	.9930	1.478	1 3/16	3.972	5.911	1 25/32	8.937	13.300
5/8	1.1003	1.638	1 7/32	4.184	6.227	1 13/16	9.253	13.770
21/32	1.2130	1.805	1 1/4	4.401	6.549	1 27/32	9.575	14.249
11/16	1.3313	1.981	1 9/32	4.624	6.881	1 7/8	9.902	14.736
23/32	1.4551	2.165	1 5/16	4.852	7.221	1 29/32	10.235	15.232
3/4	1.5844	2.358	1 11/32	5.086	7.569	1 15/16	10.573	15.735
25/32	1.7191	2.558	1 3/8	5.325	7.925	1 31/32	10.917	16.246
13/16	1.8594	2.767	1 13/32	5.570	8.289	2	11.267	16.767

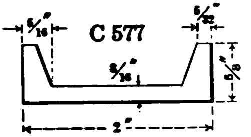
Size of Hexagon and Octagon Bars is the diameter of inscribed circle or distance between opposite faces.

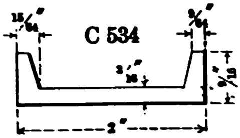
CHANNELS—BAR MILL SIZES

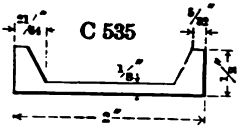


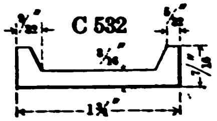


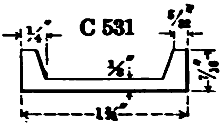










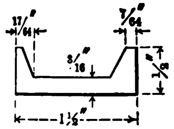


Section Index	Depth		Flange Width		Web Thickness		Weight	
	Inches	m/m	Inch	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
C 539	2½	64	13/16	20.64	⅜	9.53	3.87	5.76
	2½	64	¾	19.05	5/16	7.94	3.33	4.96
	2½	64	11/16	17.46	¼	6.35	2.80	4.17
	2½	64	⅝	15.88	3/16	4.76	2.27	3.38
C 538	2½	64	½	12.70	5/32	3.97	1.77	2.63
	2½	64	15/32	11.91	⅛	3.18	1.50	2.23
*C 556	2	51	⅝	15.88	¼	6.35	2.10	3.13
C 577	2	51	11/16	17.46	¼	6.35	2.40	3.57
	2	51	⅝	15.88	3/16	4.76	1.98	2.95
C 534	2	51	⅝	15.88	¼	6.35	2.18	3.24
	2	51	9/16	14.29	3/16	4.76	1.76	2.62
C 535	2	51	11/16	17.46	5/16	7.94	2.75	4.09
	2	51	⅝	15.88	¼	6.35	2.32	3.45
	2	51	9/16	14.29	3/16	4.76	1.90	2.83
	2	51	½	12.70	⅛	3.18	1.47	2.19
C 532	1¾	44	9/16	14.29	5/16	7.94	2.24	3.33
	1¾	44	½	12.70	¼	6.35	1.86	2.77
	1¾	44	7/16	11.11	3/16	4.76	1.49	2.22
C 531	1¾	44	9/16	14.29	¼	6.35	1.92	2.86
	1¾	44	½	12.70	3/16	4.76	1.55	2.31
	1¾	44	7/16	11.11	⅛	3.18	1.18	1.76

*Furnished only by special arrangement.
For larger sizes of channels see pages 580 to 585

CHANNELS.—BAR MILL SIZES.—*Continued*

C 529



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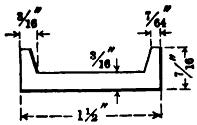

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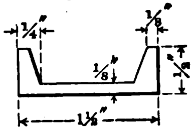

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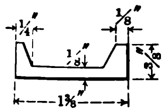

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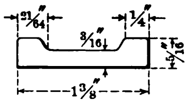

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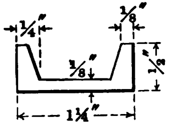

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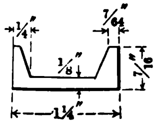

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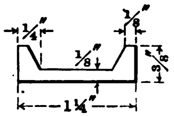

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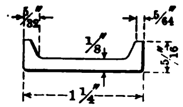

Section Index	Depth		Flange Width		Web Thickness		Weight	
	Inches	m/m	Inch	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
C 529	1½	38	9/16	14.29	1/4	6.35	1.68	2.50
	1½	38	1/2	12.70	3/16	4.76	1.36	2.02
	1½	38	7/16	11.11	1/8	3.18	1.05	1.56
C 527	1½	38	1/2	12.70	1/4	6.35	1.53	2.28
	1½	38	7/16	11.11	3/16	4.76	1.21	1.80
C 528	1½	38	5/8	15.88	1/4	6.35	1.76	2.62
	1½	38	9/16	14.29	3/16	4.76	1.44	2.14
	1½	38	1/2	12.70	1/8	3.18	1.12	1.67
C 525	1⅜	35	1/2	12.70	1/4	6.35	1.49	2.22
	1⅜	35	7/16	11.11	3/16	4.76	1.20	1.79
	1⅜	35	3/8	9.53	1/8	3.18	0.91	1.35
*C 585	1⅜	35	5/16	7.94	3/16	4.76	1.13	1.68
C 522	1¼	32	5/8	15.88	1/4	6.35	1.54	2.29
	1¼	32	9/16	14.29	3/16	4.76	1.28	1.90
	1¼	32	1/2	12.70	1/8	3.18	1.01	1.50
C 523	1¼	32	9/16	14.29	1/4	6.35	1.45	2.16
	1¼	32	1/2	12.70	3/16	4.76	1.18	1.76
	1¼	32	7/16	11.11	1/8	3.18	0.92	1.37
C 520	1¼	32	1/2	12.70	1/4	6.35	1.39	2.07
	1¼	32	7/16	11.11	3/16	4.76	1.12	1.67
	1¼	32	3/8	9.53	1/8	3.18	0.85	1.26
*C 583	1¼	32	5/16	7.94	1/8	3.18	0.68	1.01

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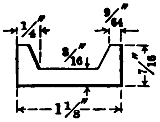
CHANNELS.—BAR MILL SIZES.—*Continued*

C 518



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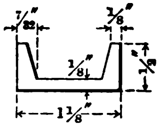

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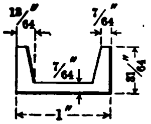

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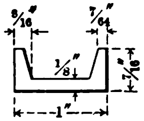

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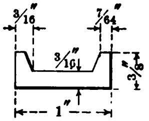

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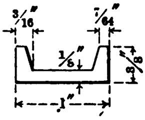

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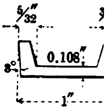

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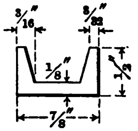

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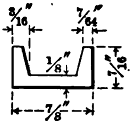

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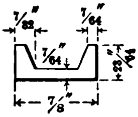
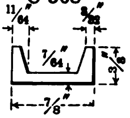


Section Index	Depth		Flange Width		Web Thickness		Weigh
	Inches	m/m	Inch	m/m	Inch	m/m	Per Foot, Pounds
C 518	1 1/8	29	1/2	12.70	1/4	6.35	1.29
	1 1/8	29	7/16	11.11	3/16	4.76	1.05
	1 1/8	29	3/8	9.53	1/8	3.18	0.81
C 519	1 1/8	29	9/16	14.29	3/16	4.76	1.16
	1 1/8	29	1/2	12.70	1/8	3.18	0.92
C 516	1	25	9/16	14.29	3/16	4.76	1.04
	1	25	1/2	12.70	1/8	3.18	0.83
	1	25	31/64	12.30	7/64	2.78	0.77
C 574	1	25	1/2	12.70	3/16	4.76	0.95
	1	25	7/16	11.11	1/8	3.18	0.75
C 586	1	25	3/8	9.53	3/16	4.76	0.83
C 513	1	25	1/2	12.70	1/4	6.35	1.10
	1	25	7/16	11.11	3/16	4.76	0.89
	1	25	3/8	9.53	1/8	3.18	0.68
C 589	1	25	3/8	9.53	.108	2.74	0.60
C 511	7/8	22	9/16	14.29	3/16	4.76	0.92
	7/8	22	1/2	12.70	1/8	3.18	0.73
C 510	7/8	22	9/16	14.29	1/4	6.35	1.06
	7/8	22	1/2	12.70	3/16	4.76	0.88
	7/8	22	7/16	11.11	1/8	3.18	0.69
C 508	7/8	22	7/16	11.11	3/16	4.76	0.84
	7/8	22	3/8	9.53	1/8	3.18	0.65
	7/8	22	23/64	9.13	7/64	2.78	0.61

CHANNELS.—BAR MILL SIZES.—*Continued*

C 568



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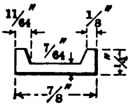

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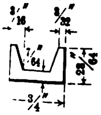
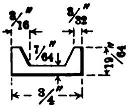
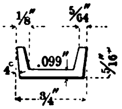


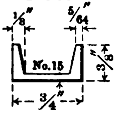
C 570



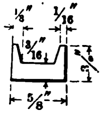
C 588



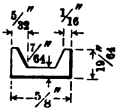
C 569



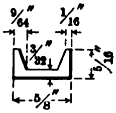
C 584



C 503



C 502



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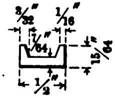

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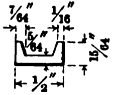
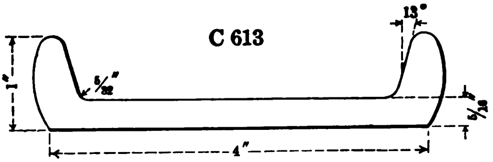
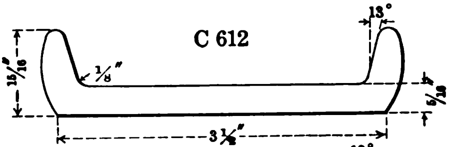
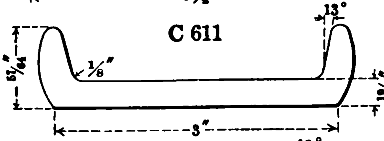


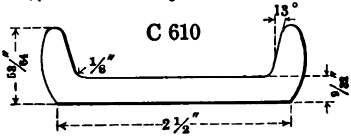
Section Index	Depth		Flange Width		Web Thickness		Weight	
	Inch	m/m	Inch	m/m	Inch	m/m	Per Foot, Pound	Per Meter, Kilos
C 568	$\frac{7}{8}$	22	$\frac{3}{8}$	9.53	$\frac{7}{64}$	2.78	0.57	0.85
C 506	$\frac{7}{8}$	22	$\frac{1}{4}$	6.35	$\frac{7}{64}$	2.78	0.47	0.70
C 571	$\frac{3}{4}$ $\frac{3}{4}$	19 19	$\frac{3}{8}$ $\frac{23}{64}$	9.53 9.13	$\frac{1}{8}$ $\frac{7}{64}$	3.18 2.78	0.56 0.52	0.83 0.77
C 570	$\frac{3}{4}$ $\frac{3}{4}$	19 19	$\frac{5}{16}$ $\frac{19}{64}$	7.94 7.54	$\frac{1}{8}$ $\frac{7}{64}$	3.18 2.78	0.50 0.46	0.74 0.68
C 588	$\frac{3}{4}$	19	$\frac{5}{16}$	7.94	.099	2.51	0.40	0.60
C 569	$\frac{3}{4}$	19	$\frac{3}{8}$	9.53	No. 15. B. W. G.	1.83	0.40	0.60
C 584	$\frac{5}{8}$	16	$\frac{3}{8}$	9.53	$\frac{3}{16}$	4.76	0.52	0.77
C 503	$\frac{5}{8}$ $\frac{5}{8}$	16 16	$\frac{5}{16}$ $\frac{19}{64}$	7.94 7.54	$\frac{1}{8}$ $\frac{7}{64}$	3.18 2.78	0.41 0.38	0.61 0.57
C 502	$\frac{5}{8}$	16	$\frac{5}{16}$	7.94	$\frac{3}{32}$	2.38	0.35	0.52
C 500	$\frac{1}{2}$ $\frac{1}{2}$	13 13	$\frac{1}{4}$ $\frac{15}{64}$	6.35 5.95	$\frac{1}{8}$ $\frac{7}{64}$	3.18 2.78	0.28 0.26	0.42 0.39
C 501	$\frac{1}{2}$ $\frac{1}{2}$	13 13	$\frac{1}{4}$ $\frac{15}{64}$	6.35 5.95	$\frac{3}{32}$ $\frac{5}{64}$	2.38 1.98	0.25 0.23	0.37 0.34

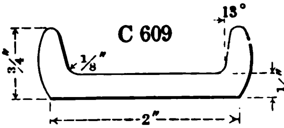
SOLID RUBBER TIRE CHANNELS

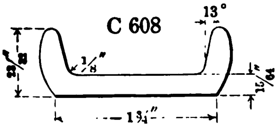


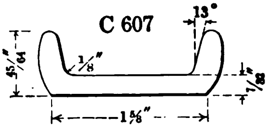








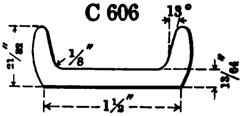




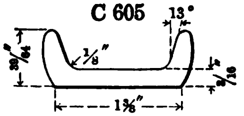
Section Index	Base		Depth		Web Thickness		Weight	
	Inches	m/m	Inch	m/m	Inch	m/m	Per Foot, Pounds	P Me Ki
C 613	4	102	1	25.40	5/16	7.94	6.7	9.
C 612	3½	89	15/16	23.81	5/16	7.94	5.4	8.
C 611	3	76	57/64	22.62	19/64	7.54	4.3	6.
C 610	2½	64	53/64	21.03	9/32	7.14	3.6	5.
C 609	2	51	3/4	19.05	1/4	6.35	2.7	4.
C 608	1¾	44	23/32	18.26	15/64	5.95	2.2	3.
C 607	1⅝	41	45/64	17.86	7/32	5.56	2.0	2.

SOLID RUBBER TIRE CHANNELS.—*Continued*

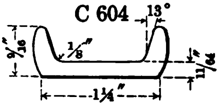
C 606



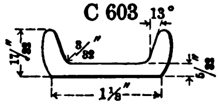
C 605



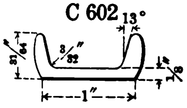
C 604



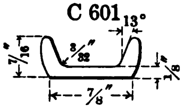
C 603



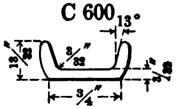
C 602



C 601



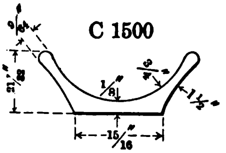
C 600



CUSHION TIRE CHANNELS

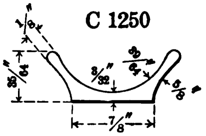
Commercial Name: 1½

C 1500



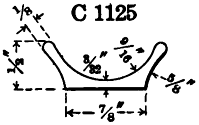
Commercial Name: 1¼

C 1250



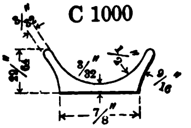
Commercial Name: 1⅛

C 1125



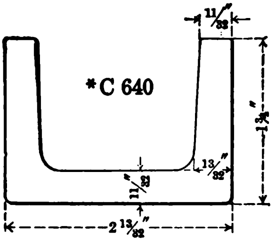
Commercial Name: 1

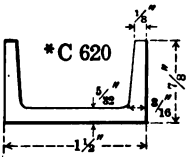
C 1000



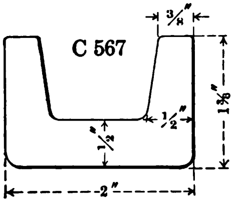
Section Index	Base		Depth		Web Thickness		Weight	
	Inches	m/m	Inch	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
C 606	1½	38	21/32	16.67	13/64	5.16	1.80	2.68
C 605	1⅜	35	39/64	15.48	3/16	4.76	1.50	2.23
C 604	1¼	32	9/16	14.29	11/64	4.37	1.20	1.79
C 603	1⅛	29	17/32	13.49	5/32	3.97	1.00	1.49
C 602	1	25	31/64	12.30	⅛	3.18	0.79	1.18
C 601	⅞	22	7/16	11.11	⅛	3.18	0.67	1.00
C 600	¾	19	13/32	10.32	3/32	2.38	0.51	0.76
C 1500	15/16	24	21/32	16.67	⅛	3.18	1.11	1.65
C 1250	⅞	22	35/64	13.89	3/32	2.38	0.80	1.19
C 1125	⅞	22	½	12.70	3/32	2.38	0.75	1.12
C 1000	⅞	22	29/64	11.51	3/32	2.38	0.68	1.01

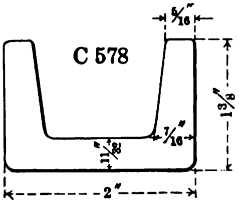
MISCELLANEOUS CHANNELS



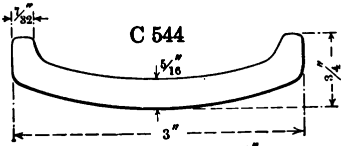


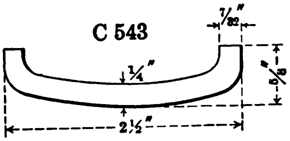
BRAKE BEAM CHANNELS

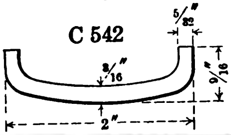


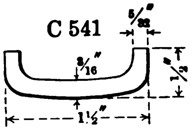


ROUND BACK CHANNELS





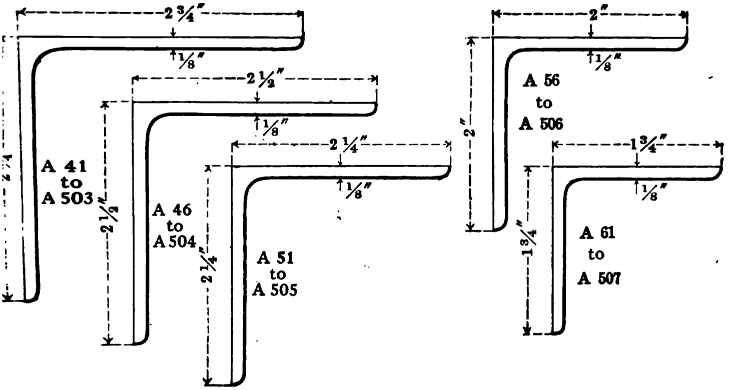




Section Index	Depth		Flange Width		Web Thickness		Weight	
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	P Me Ki
*C 640	2 13/32	61	1¾	44	11/32	8.73	6.4	9.
*C 620	1½	38	⅞	22	5/32	3.97	1.57	2.
C 567	2	51	1⅜	35	½	12.70	6.0	8.
C 578	2	51	1⅜	35	11/32	8.73	5.0	7.
C 544	3	76	¾	19	5/16	7.94	3.65	5.
C 543	2½	64	⅝	16	¼	6.35	2.40	3.
C 542	2	51	9/16	14	3/16	4.76	1.67	2.
C 541	1½	38	½	13	3/16	4.76	1.33	1.

*Furnished only by special arrangement.

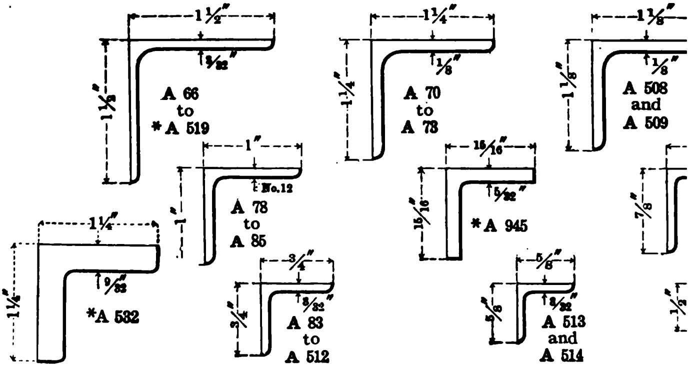
ANGLES WITH EQUAL LEGS—BAR MILL SIZES



Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
A 41	2¾ x 2¾	70 x 70	½	12.70	8.5	12.65
A 42	2¾ x 2¾	70 x 70	7/16	11.11	7.6	11.31
A 43	2¾ x 2¾	70 x 70	⅜	9.53	6.6	9.82
A 44	2¾ x 2¾	70 x 70	5/16	7.94	5.6	8.33
A 45	2¾ x 2¾	70 x 70	¼	6.35	4.5	6.70
A 502	2¾ x 2¾	70 x 70	3/16	4.76	3.39	5.04
A 503	2¾ x 2¾	70 x 70	⅛	3.18	2.29	3.41
A 46	2½ x 2½	64 x 64	½	12.70	7.7	11.46
A 47	2½ x 2½	64 x 64	7/16	11.11	6.8	10.12
A 48	2½ x 2½	64 x 64	⅜	9.53	5.9	8.78
A 49	2½ x 2½	64 x 64	5/16	7.94	5.0	7.44
A 50	2½ x 2½	64 x 64	¼	6.35	4.1	6.10
A 100	2½ x 2½	64 x 64	3/16	4.76	3.07	4.57
A 504	2½ x 2½	64 x 64	⅛	3.18	2.08	3.10
A 51	2¼ x 2¼	57 x 57	½	12.70	6.8	10.12
A 52	2¼ x 2¼	57 x 57	7/16	11.11	6.1	9.08
A 53	2¼ x 2¼	57 x 57	⅜	9.53	5.3	7.89
A 54	2¼ x 2¼	57 x 57	5/16	7.94	4.5	6.70
A 55	2¼ x 2¼	57 x 57	¼	6.35	3.62	5.39
A 101	2¼ x 2¼	57 x 57	3/16	4.76	2.75	4.09
A 505	2¼ x 2¼	57 x 57	⅛	3.18	1.86	2.77
A 56	2 x 2	51 x 51	7/16	11.11	5.3	7.89
A 57	2 x 2	51 x 51	⅜	9.53	4.7	6.99
A 58	2 x 2	51 x 51	5/16	7.94	3.92	5.83
A 59	2 x 2	51 x 51	¼	6.35	3.19	4.75
A 60	2 x 2	51 x 51	3/16	4.76	2.44	3.63
A 506	2 x 2	51 x 51	⅛	3.18	1.65	2.46
A 61	1¾ x 1¾	44 x 44	7/16	11.11	4.6	6.85
A 62	1¾ x 1¾	44 x 44	⅜	9.53	3.99	5.94
A 63	1¾ x 1¾	44 x 44	5/16	7.94	3.39	5.04
A 64	1¾ x 1¾	44 x 44	¼	6.35	2.77	4.12
A 65	1¾ x 1¾	44 x 44	3/16	4.76	2.12	3.15
A 507	1¾ x 1¾	44 x 44	⅛	3.18	1.44	2.14

For *larger sizes of Angles with Equal Legs,* see pages 596 to 598.

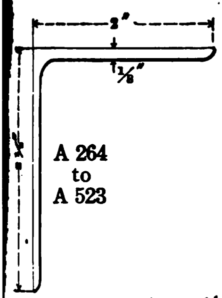
Angles with Equal Legs.—Bar Mill Sizes.—*Continued*

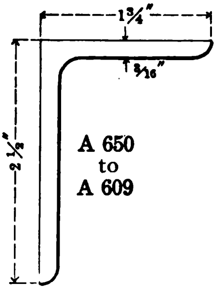


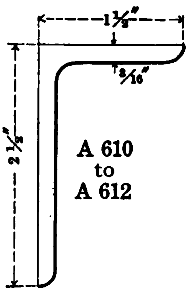
Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Pe
A 66	1½ x 1½	38 x 38	⅜	9.53	3.35	
A 67	1½ x 1½	38 x 38	5/16	7.94	2.86	
A 68	1½ x 1½	38 x 38	¼	6.35	2.34	
A 69	1½ x 1½	38 x 38	3/16	4.76	1.80	
A 102	1½ x 1½	38 x 38	⅛	3.18	1.23	
*A 519	1½ x 1½	38 x 38	3/32	2.38	0.93	
*A 532	1¼ x 1¼	32 x 32	9/32	7.14	2.13	
A 70	1¼ x 1¼	32 x 32	5/16	7.94	2.33	
A 71	1¼ x 1¼	32 x 32	¼	6.35	1.92	
A 72	1¼ x 1¼	32 x 32	3/16	4.76	1.48	
A 73	1¼ x 1¼	32 x 32	⅛	3.18	1.01	
A 508	1⅛ x 1⅛	29 x 29	3/16	4.76	1.32	
A 509	1⅛ x 1⅛	29 x 29	⅛	3.18	0.91	
A 78	1 x 1	25 x 25	¼	6.35	1.49	
A 79	1 x 1	25 x 25	3/16	4.76	1.16	
A 80	1 x 1	25 x 25	⅛	3.18	0.80	
A 85	1 x 1	25 x 25	No. 12 B.W.G.	2.77	0.71	
*A 945	15/16 x 15/16	24 x 24	5/32	3.97	0.91	
A 81	⅞ x ⅞	22 x 22	3/16	4.76	1.00	
A 82	⅞ x ⅞	22 x 22	⅛	3.18	0.70	
A 511	⅞ x ⅞	22 x 22	3/32	2.38	0.53	
A 83	¾ x ¾	19 x 19	3/16	4.76	0.84	
A 84	¾ x ¾	19 x 19	⅛	3.18	0.59	
A 512	¾ x ¾	19 x 19	3/32	2.38	0.45	
*A 534	11/16 x 11/16	17 x 17	5/32	3.97	0.62	
A 513	⅝ x ⅝	16 x 16	⅛	3.18	0.48	
A 514	⅝ x ⅝	16 x 16	3/32	2.38	0.37	
*A 535	9/16 x 9/16	14 x 14	5/32	3.97	0.49	
A 515	½ x ½	13 x 13	⅛	3.18	0.38	
A 516	½ x ½	13 x 13	3/32	2.38	0.29	

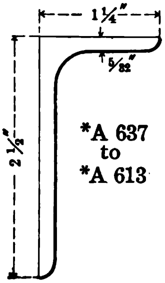
*Furnished only by special arrangement.

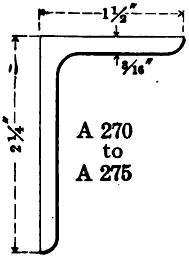
ANGLES WITH UNEQUAL LEGS—BAR MILL SIZES







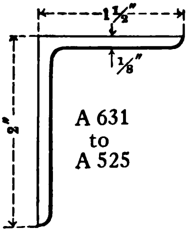


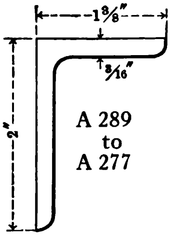


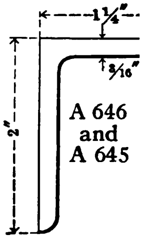
Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
A 264	2½ x 2	64 x 51	½	12.70	6.8	10.12
A 265	2½ x 2	64 x 51	7/16	11.11	6.1	9.08
A 266	2½ x 2	64 x 51	⅜	9.53	5.3	7.89
A 267	2½ x 2	64 x 51	5/16	7.94	4.5	6.70
A 268	2½ x 2	64 x 51	¼	6.35	3.62	5.39
A 269	2½ x 2	64 x 51	3/16	4.76	2.75	4.09
A 523	2½ x 2	64 x 51	⅛	3.18	1.86	2.77
A 650	2½ x 1¾	64 x 44	5/16	7.94	4.2	6.25
A 608	2½ x 1¾	64 x 44	¼	6.35	3.4	5.06
A 609	2½ x 1¾	64 x 44	3/16	4.76	2.59	3.85
A 610	2½ x 1½	64 x 38	5/16	7.94	3.92	5.83
A 611	2½ x 1½	64 x 38	¼	6.35	3.19	4.75
A 612	2½ x 1½	64 x 38	3/16	4.76	2.44	3.63
*A 637	2½ x 1¼	64 x 32	3/16	4.76	2.28	3.39
*A 613	2½ x 1¼	64 x 32	5/32	3.97	1.91	2.84
A 270	2¼ x 1½	57 x 38	½	12.70	5.6	8.33
A 271	2¼ x 1½	57 x 38	7/16	11.11	5.0	7.44
A 272	2¼ x 1½	57 x 38	⅜	9.53	4.4	6.55
A 273	2¼ x 1½	57 x 38	5/16	7.94	3.66	5.45
A 274	2¼ x 1½	57 x 38	¼	6.35	2.98	4.43
A 275	2¼ x 1½	57 x 38	3/16	4.76	2.28	3.39

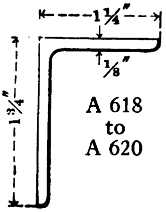
*Furnished only by special arrangement.
For larger sizes of *Angles with Unequal Legs*, see pages 599 to 604.

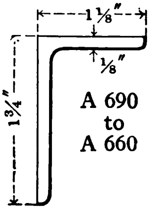
Angles with Unequal Legs.—Bar Mill Sizes.—*Continued*

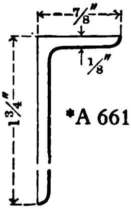








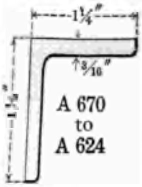


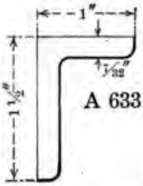


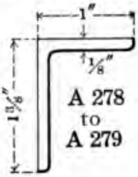
Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Pe
A 631	2 x 1½	51 x 38	⅜	9.53	3.99	
A 614	2 x 1½	51 x 38	5/16	7.94	3.39	
A 615	2 x 1½	51 x 38	¼	6.35	2.77	
A 616	2 x 1½	51 x 38	3/16	4.76	2.12	
A 525	2 x 1½	51 x 38	⅛	3.18	1.44	
A 289	2 x 1⅜	51 x 35	⅜	9.53	3.83	
A 290	2 x 1⅜	51 x 35	5/16	7.94	3.26	
A 276	2 x 1⅜	51 x 35	¼	6.35	2.66	
A 277	2 x 1⅜	51 x 35	3/16	4.76	2.04	
A 646	2 x 1¼	51 x 32	¼	6.35	2.55	
A 645	2 x 1¼	51 x 32	3/16	4.76	1.96	
*A 538	2 x 1	51 x 25	3/16	4.76	1.80	
A 618	1¾ x 1¼	44 x 32	¼	6.35	2.34	
A 619	1¾ x 1¼	44 x 32	3/16	4.76	1.80	
A 620	1¾ x 1¼	44 x 32	⅛	3.18	1.23	
A 690	1¾ x 1⅛	44 x 29	5/16	7.94	2.73	
A 621	1¾ x 1⅛	44 x 29	¼	6.35	2.24	
A 622	1¾ x 1⅛	44 x 29	3/16	4.76	1.72	
A 660	1¾ x 1⅛	44 x 29	⅛	3.18	1.17	
*A 661	1¾ x ⅞	44 x 22	⅛	3.18	1.07	

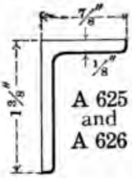
*Furnished only by special arrangement.

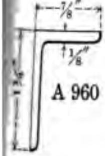
ANGLES WITH UNEQUAL LEGS.—BAR MILL SIZES.—*Continued*

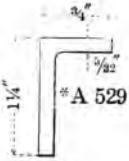


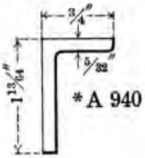


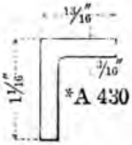


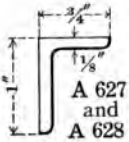


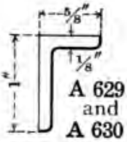


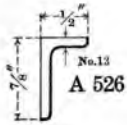


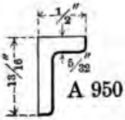








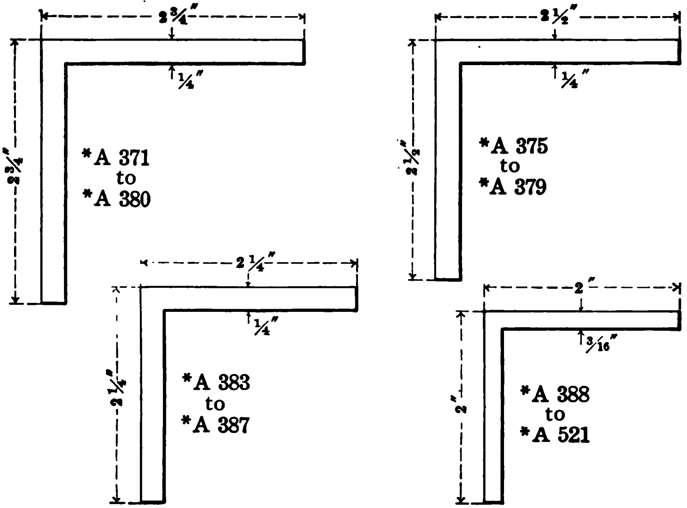




Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
A 670	1½ x 1¼	38 x 32	5/16	7.94	2.59	3.85
A 623	1½ x 1¼	38 x 32	¼	6.35	2.13	3.17
A 624	1½ x 1¼	38 x 32	3/16	4.76	1.64	2.44
A 633	1½ x 1	38 x 25	7/32	5.56	1.70	2.53
A 278	1⅜ x 1	35 x 25	¼	6.35	1.81	2.69
A 281	1⅜ x 1	35 x 25	3/16	4.76	1.40	2.08
A 279	1⅜ x 1	35 x 25	⅛	3.18	0.96	1.43
A 625	1⅜ x ⅞	35 x 22	3/16	4.76	1.32	1.96
A 626	1⅜ x ⅞	35 x 22	⅛	3.18	0.91	1.35
A 960	1¼ x ⅞	32 x 22	⅛	3.18	0.85	1.26
*A 529	1¼ x ¾	32 x 20	5/32	3.97	0.98	1.46
*A 940	1 13/64 x ¾	31 x 19	5/32	3.97	0.96	1.43
*A 430	1 1/16 x 13/16	27 x 21	3/16	4.76	1.08	1.6
*A 533	1 1/16 x 21/32	27 x 17	5/32	3.97	0.83	1.23
A 627	1 x ¾	25 x 19	3/16	4.76	1.00	1.49
A 628	1 x ¾	25 x 19	⅛	3.18	0.70	1.04
A 629	1 x ⅝	25 x 16	3/16	4.76	0.92	1.37
A 630	1 x ⅝	25 x 16	⅛	3.18	0.64	0.95
A 526	⅞ x ½	22 x 13	No. 13 B.W.G.	2.41	0.42	0.63
A 950	13/16 x ½	21 x 13	5/32	3.97	0.62	0.92
*A 955	7/16 x ⅜	11 x 9	1/16	1.59	0.16	0.24

**Furnished only by special arrangement.*

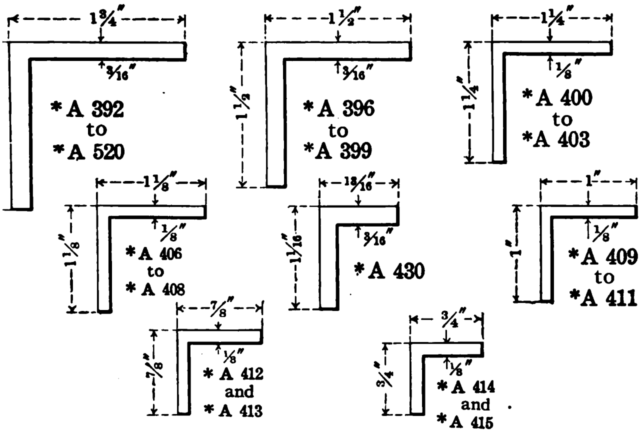
SQUARE ROOT ANGLES—BAR MILL SIZES



Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
*A 371	2¾ x 2¾	70 x 70	½	12.70	8.5	12.65
*A 372	2¾ x 2¾	70 x 70	7/16	11.11	7.6	11.31
*A 373	2¾ x 2¾	70 x 70	⅜	9.53	6.6	9.82
*A 374	2¾ x 2¾	70 x 70	5/16	7.94	5.6	8.33
*A 380	2¾ x 2¾	70 x 70	¼	6.35	4.5	6.70
*A 375	2½ x 2½	64 x 64	½	12.70	7.7	11.46
*A 376	2½ x 2½	64 x 64	7/16	11.11	6.8	10.12
*A 377	2½ x 2½	64 x 64	⅜	9.53	5.9	8.78
*A 378	2½ x 2½	64 x 64	5/16	7.94	5.0	7.44
*A 379	2½ x 2½	64 x 64	¼	6.35	4.1	6.10
*A 383	2¼ x 2¼	57 x 57	½	12.70	6.8	10.12
*A 384	2¼ x 2¼	57 x 57	7/16	11.11	6.1	9.08
*A 385	2¼ x 2¼	57 x 57	⅜	9.53	5.3	7.89
*A 386	2¼ x 2¼	57 x 57	5/16	7.94	4.5	6.70
*A 387	2¼ x 2¼	57 x 57	¼	6.35	3.62	5.39
*A 388	2 x 2	51 x 51	7/16	11.11	5.3	7.89
*A 389	2 x 2	51 x 51	⅜	9.53	4.7	6.99
*A 390	2 x 2	51 x 51	5/16	7.94	3.92	5.83
*A 391	2 x 2	51 x 51	¼	6.35	3.19	4.75
*A 521	2 x 2	51 x 51	3/16	4.76	2.44	3.63

*Furnished only by special arrangement.
For larger sizes of Square Root Angles, see page 605.

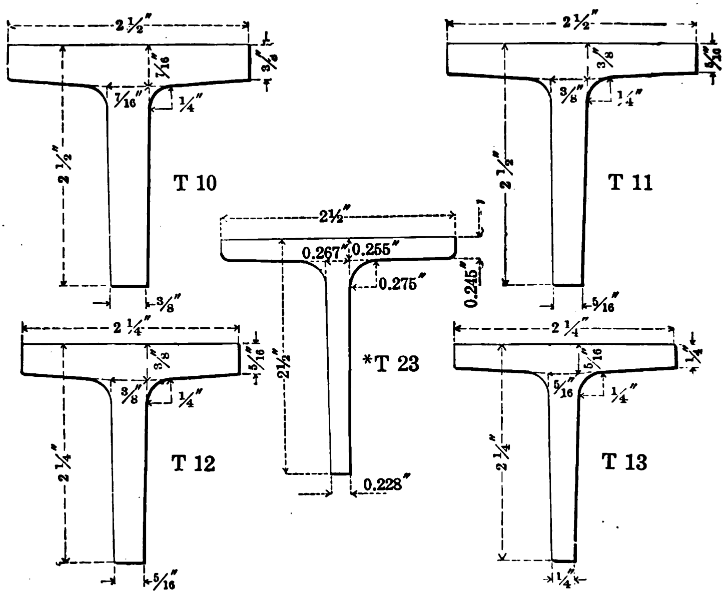
Square Root Angles.—Bar Mill Sizes.—*Continued*



on ex	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
92	1¾ x 1¾	44 x 44	7/16	11.11	4.60	6.85
93	1¾ x 1¾	44 x 44	⅜	9.53	3.99	5.94
94	1¾ x 1¾	44 x 44	5/16	7.94	3.39	5.04
95	1¾ x 1¾	44 x 44	¼	6.35	2.77	4.12
20	1¾ x 1¾	44 x 44	3/16	4.76	2.12	3.15
04	1 9/16 x 1 9/16	40 x 40	¼	6.35	2.44	3.63
96	1½ x 1½	38 x 38	⅜	9.53	3.35	4.99
97	1½ x 1½	38 x 38	5/16	7.94	2.86	4.26
98	1½ x 1½	38 x 38	¼	6.35	2.34	3.48
99	1½ x 1½	38 x 38	3/16	4.76	1.80	2.68
00	1¼ x 1¼	32 x 32	5/16	7.94	2.33	3.47
01	1¼ x 1¼	32 x 32	¼	6.35	1.92	2.86
02	1¼ x 1¼	32 x 32	3/16	4.76	1.48	2.20
03	1¼ x 1¼	32 x 32	⅛	3.18	1.01	1.50
06	1⅛ x 1⅛	29 x 29	¼	6.35	1.70	2.53
07	1⅛ x 1⅛	29 x 29	3/16	4.76	1.32	1.96
08	1⅛ x 1⅛	29 x 29	⅛	3.18	0.91	1.35
09	1 x 1	25 x 25	¼	6.35	1.49	2.22
10	1 x 1	25 x 25	3/16	4.76	1.16	1.73
11	1 x 1	25 x 25	⅛	3.18	0.80	1.19
12	⅞ x ⅞	22 x 22	3/16	4.76	1.00	1.49
13	⅞ x ⅞	22 x 22	⅛	3.18	0.70	1.04
14	¾ x ¾	19 x 19	3/16	4.76	0.84	1.25
15	¾ x ¾	19 x 19	⅛	3.18	0.59	0.88

*Furnished only by special arrangement.

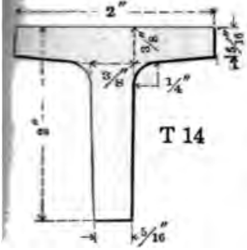
TEES WITH EQUAL LEGS—BAR MILL SIZES

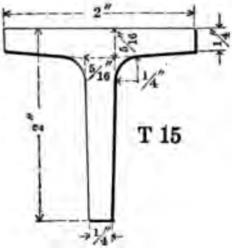


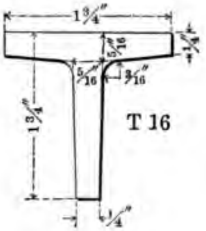
Section Index	Size				Thickness of Metal			Weight	
	Inches		m/m		Inch		m/m	Per Foot, Pounds	Per Meter, Kilos
	Flange	Stem	Flange	Stem	Flange	Stem	Flange and Stem		
T 10	2½	2½	64	64	⅜ to 7/16	⅜ to 7/16	9.53 to 11.11	6.4	9.52
T 11	2½	2½	64	64	5/16 to ⅜	5/16 to ⅜	7.94 to 9.53	5.5	8.19
*T 23	2½	2½	64	64	0.245 to 0.255	0.228 to 0.267	†	4.1	6.10
T 12	2¼	2¼	57	57	5/16 to ⅜	5/16 to ⅜	7.94 to 9.53	4.9	7.29
T 13	2¼	2¼	57	57	¼ to 5/16	¼ to 5/16	6.35 to 7.94	4.1	6.10

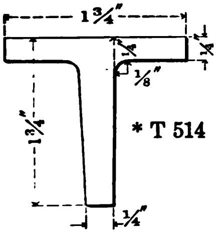
*Furnished only by special arrangement.
†Flange—6.22 to 6.48 m/m; Stem—5.79 to 6.78 m/m.
For larger sizes of Tees with Equal Legs, see pages 615 and 616.

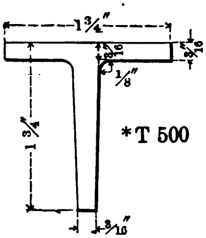
TEES WITH EQUAL LEGS.—BAR MILL SIZES.—*Continued*

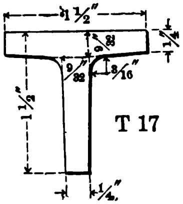


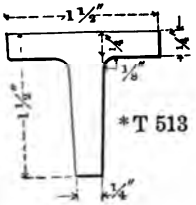


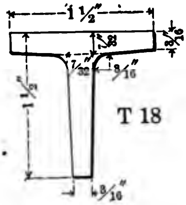


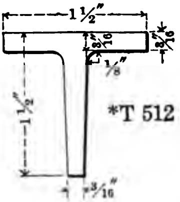








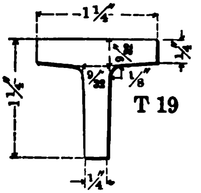


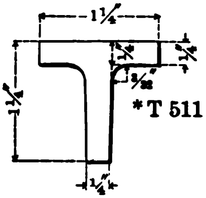


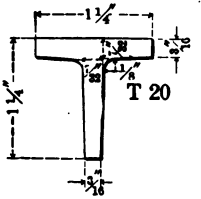
Section Index	Size				Thickness of Metal			Weight	
	Inches		m/m		Inch		m/m	Per Foot, Pounds	Per Meter, Kilos
	Flange	Stem	Flange	Stem	Flange	Stem	Flange and Stem		
T 14	2	2	51	51	5/16 to 3/8	5/16 to 3/8	7.94 to 9.53	4.3	6.40
T 15	2	2	51	51	1/4 to 5/16	1/4 to 5/16	6.35 to 7.94	3.56	5.30
T 16	1 3/4	1 3/4	45	45	1/4 to 5/16	1/4 to 5/16	6.35 to 7.94	3.09	4.60
*T 514	1 3/4	1 3/4	45	45	1/4 to 1/4	1/4	6.35	2.90	4.32
*T 500	1 3/4	1 3/4	45	45	3/16 to 3/16	3/16	4.76	2.26	3.36
T 17	1 1/2	1 1/2	38	38	1/4 to 9/32	1/4 to 9/32	6.35 to 7.15	2.47	3.68
*T 513	1 1/2	1 1/2	38	38	1/4 to 1/4	1/4	6.35	2.43	3.62
T 18	1 1/2	1 1/2	38	38	3/16 to 7/32	3/16 to 7/32	4.76 to 5.56	1.94	2.89
*T 512	1 1/2	1 1/2	38	38	3/16 to 3/16	3/16	4.76	1.90	2.83

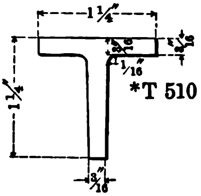
***Rolled approximately to one degree taper each side of stem.**

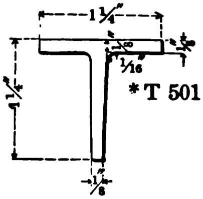
TEES WITH EQUAL LEGS.—BAR MILL SIZES.—*Continued*

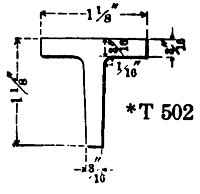


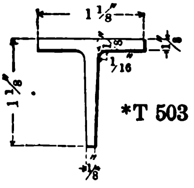








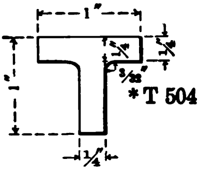




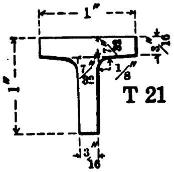
Section Index	Size				Thickness of Metal			Weight	
	Inches		m/m		Inch		m/m	Per Foot, Pounds	P Me Ki
	Flange	Stem	Flange	Stem	Flange	Stem	Flange and Stem		
T 19	1¼	1¼	32	32	¼ to 9/32	¼ to 9/32	6.35 to 7.15	2.02	3.
*T 511	1¼	1¼	32	32	¼ to ¼	¼	6.35	1.98	2.
T 20	1¼	1¼	32	32	3/16 to 7/32	3/16 to 7/32	4.76 to 5.56	1.59	2.
*T 510	1¼	1¼	32	32	3/16 to 3/16	3/16	4.76	1.55	2.
*T 501	1¼	1¼	32	32	⅛ to ⅛	⅛	3.18	1.09	1.
*T 502	1⅛	1⅛	29	29	3/16 to 3/16	3/16	4.76	1.37	2.
*T 503	1⅛	1⅛	29	29	⅛ to ⅛	⅛	3.18	0.97	1.

*Rolled approximately to one degree taper each side of stem.

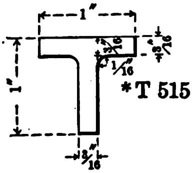
TEES WITH EQUAL LEGS.—BAR MILL SIZES.—*Continued*



***T 504**



T 21



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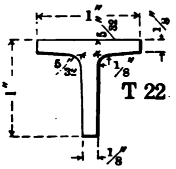
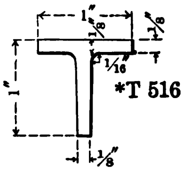


T 22



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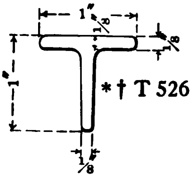
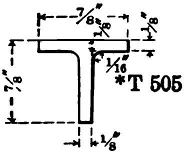


***† T 526**



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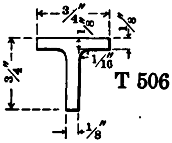
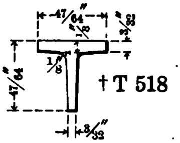
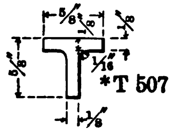


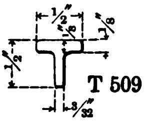
T 506



† T 518



***T 507**

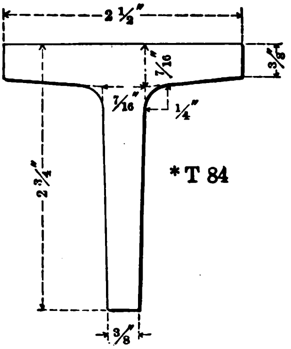


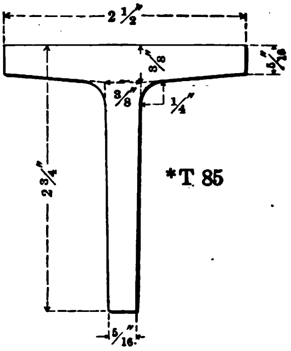
T 509

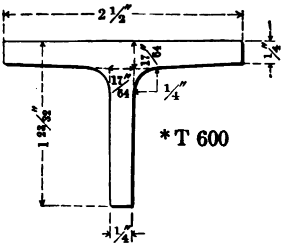
ction ndex	Size				Thickness of Metal			Weight	
	Inches		m/m		Inch		m/m	Per Foot, Pounds	Per Meter, Kilos
	Flange	Stem	Flange	Stem	Flange	Stem	Flange and Stem		
504	1	1	25	25	1/4 to 1/4	1/4	6.35	1.53	2.28
21	1	1	25	25	3/16 to 7/32	3/16 to 7/32	4.76 to 5.56	1.25	1.86
515	1	1	25	25	3/16 to 3/16	3/16	4.76	1.20	1.79
22	1	1	25	25	1/8 to 5/32	1/8 to 5/32	3.18 to 3.97	0.89	1.32
516	1	1	25	25	1/8 to 1/8	1/8	3.18	0.85	1.26
526	1	1	25	25	1/8 to 1/8	1/8	3.18	0.83	1.24
505	7/8	7/8	22	22	1/8 to 1/8	1/8	3.18	0.73	1.09
506	3/4	3/4	19	19	1/8 to 1/8	1/8	3.18	0.61	0.91
518	47/64	47/64	19	19	3/32 to 1/8	3/32 to 1/8	2.38 to 3.18	0.51	0.76
507	5/8	5/8	16	16	1/8 to 1/8	1/8	3.18	0.50	0.74
509	1/2	1/2	13	13	1/8 to 1/8	3/32 to 3/32	3.18 and 2.38	0.34	0.51

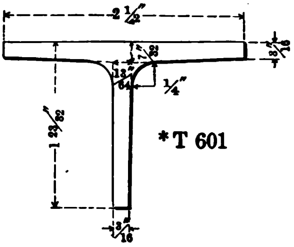
*Rolled approximately to one degree taper each side of stem.
†Furnished only by special arrangement.

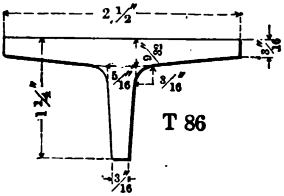
TEES WITH UNEQUAL LEGS—BAR MILL SIZES

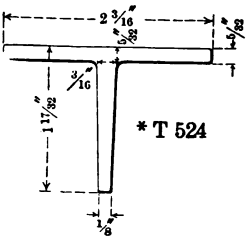


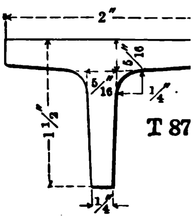










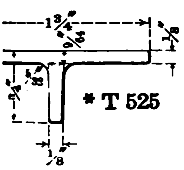


Section Index	Size				Thickness of Metal				Wei
	Inches		m/m		Flange		Stem		Per Foot, Lbs.
	Flange	Stem	Flange	Stem	Inch	m/m	Inch	m/m	
*T 84	2 1/2	2 3/4	64	70	3/8 to 7/16	9.53 to 11.11	3/8 to 7/16	9.53 to 11.11	6.7
*T 85	2 1/2	2 3/4	64	70	5/16 to 3/8	7.94 to 9.53	5/16 to 3/8	7.94 to 9.53	5.8
*T 600	2 1/2	1 23/32	64	44	1/4 to 17/64	6.35 to 6.75	1/4 to 17/64	6.35 to 6.75	3.48
*T 601	2 1/2	1 23/32	64	44	3/16 to 7/32	4.76 to 5.56	3/16 to 13/64	4.76 to 5.16	2.74
T 86	2 1/2	1 1/4	64	32	3/16 to 9/32	4.76 to 7.15	3/16 to 5/16	4.76 to 7.94	2.87
*T 524	2 3/16	1 17/32	56	39	5/32 to 5/32	3.97 to 3.97	1/8 to 3/16	3.18 to 4.76	1.90
T 87	2	1 1/2	51	38	1/4 to 5/16	6.35 to 7.94	1/4 to 5/16	6.35 to 7.94	3.09

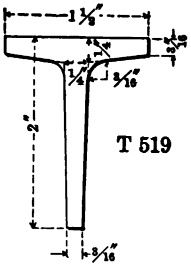
**Furnished only by special arrangement.*

For larger sizes of Tees with Unequal Legs, see pages 617 to 621.

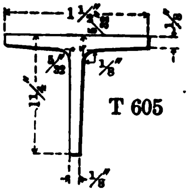
TEES WITH UNEQUAL LEGS.—BAR MILL SIZES.—*Continued*



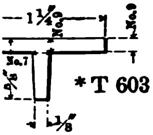
*** T 525**



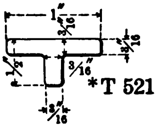
T 519



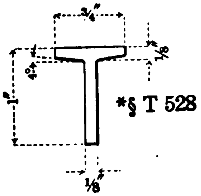
T 605



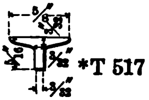
*** T 603**



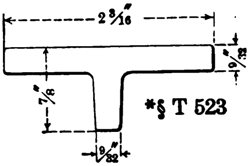
*** T 521**



***§ T 528**



***T 517**



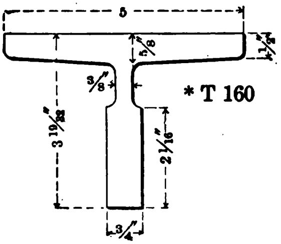
***§ T 523**

tion dex	Size				Thickness of Metal				Weight	
	Inches		m/m		Flange		Stem		Per Foot, Lbs.	Per Meter, Kilos
	Flange	Stem	Flange	Stem	Inch	m/m	Inch	m/m		
T 525	1¾	¾	44	19	⅛ to 9/64	3.18 to 3.57	⅛ to 5/32	3.18 to 3.97	1.10	1.64
T 519	1½	2	38	51	3/16 to ¼	4.76 to 6.35	3/16 to ¼	4.76 to 6.35	2.45	3.65
T 605	1½	1¼	38	32	⅛ to 5/32	3.18 to 3.97	⅛ to 5/32	3.18 to 3.97	1.25	1.86
T 603	1¼	⅝	32	16	No. 9	3.76	⅛toNo.7	3.18 to 4.57	0.88	1.31
T 521	1	½	25	13	3/16 to 3/16	4.76	3/16 to 3/16	4.76	0.84	1.25
T 522	⅞	¾	22	19	3/16	4.76	⅛	3.18	0.81	1.21
T 528	¾	1	19	25	See	Cut	⅛	3.18	0.72	1.07
T 517	⅝	5/16	16	8	See	Cut	3/32 to 3/32	2.38	0.23	0 34
T 523	2 3/16	⅞	56	22	9/32 to 9/32	7.14 to 7.14	9/32	7.14	2.68	3.99

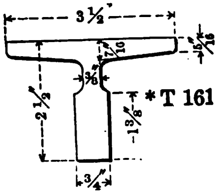
*Furnished only by special arrangement.
†Rolled approximately to one degree taper each side of stem.

MISCELLANEOUS TEES

ELEVATOR TEES

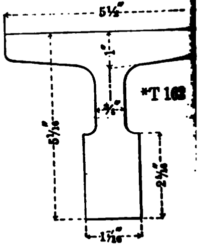


*T 160



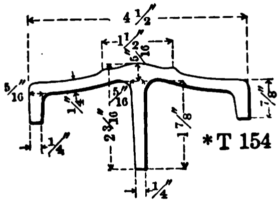
*T 161

CRANE RAIL T



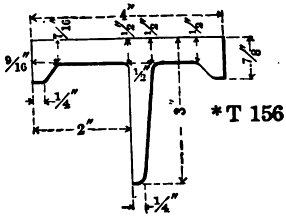
*T 16

HAND RAIL TEE



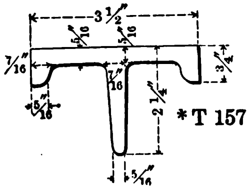
*T 154

CAR TRUCK TEE

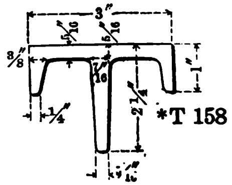


*T 156

CONDUCTOR RAIL TEES



*T 157

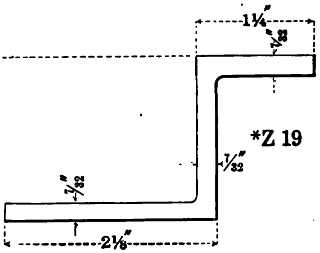


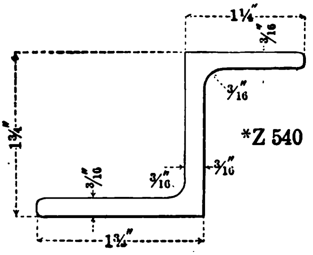
*T 158

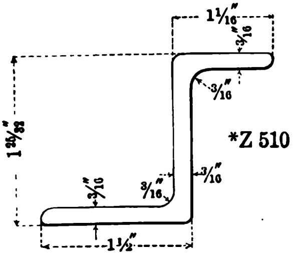
Section Index	Size				Thickness of Metal				Weigh	
	Inches		m/m		Flange		Stem		Per Foot, Lbs.	I M K
	Flange	Stem	Flange	Stem	Inch	m/m	Inch	m/m		
*T 162	5½	5 1/16	140	129	11/16 to 1	17.46 to 25.40	See	Cut	31.6	4
*T 160	5	3 19/32	127	91	½ to ⅝	12.70 to 15.88	⅜ to ¾	9.53 to 19.05	16.3	2
*T 161	3½	2½	89	64	5/16 to 7/16	7.94 to 11.11	⅜ to ¾	9.53 to 19.05	9.0	1
*T 154	4½	1⅞	114	48	See Cut	....	¼ to 5/16	6.35 to 7.94	7.0	1
*T 156	4	3	102	76	See Cut	....	¼ to ½	6.35 to 12.70	11.3	1
*T 157	3½	2¼	89	57	See Cut	....	5/16 to 7/16	7.94 to 11.11	7.3	1
*T 158	3	2¼	76	57	See Cut	....	5/16 to 7/16	7.94 to 11.11	7.0	1

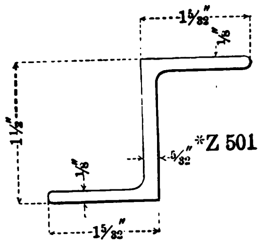
*Furnished only by special arrangement.

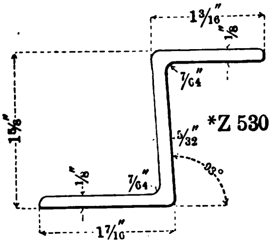
Z-BARS—BAR MILL SIZES







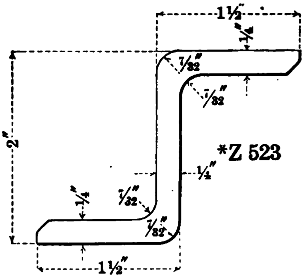


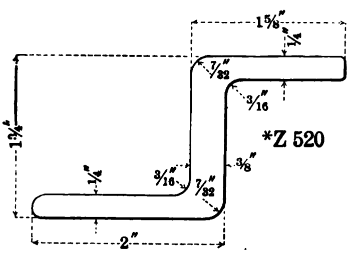


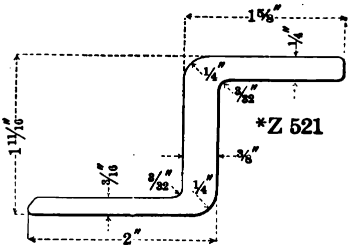
n x	Size		Thickness of Metal		Weight	
	Inches Flange Web Flange	Millimeters (Approximate)	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
19	1¼ x 1¾ x 2⅛	32 x 44 x 54	7/32	5.56	3.49	5.19
40	1¼ x 1¾ x 1¾	32 x 44 x 44	3/16	4.76	2.79	4.15
10	1 1/16 x 1 25/32 x 1½	27 x 45 x 38	3/16	4.76	2.53	3.77
01	1 5/32 x 1½ x 1 5/32	29 x 38 x 29	⅛, 5/32, ⅛	3.18 3.97 3.18	1.65	2.46
30	1 3/16 x 1⅝ x 1 7/16	30 x 41 x 37	⅛, 5/32, ⅛	3.18 3.97 3.18	1.85	2.75

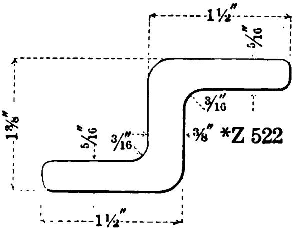
rnished only by special arrangement.
larger sizes of Z-Bars, see pages *622 to 624*.

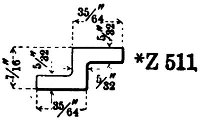
Z-Bars.—Bar Mill Sizes.—*Continued*

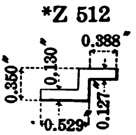










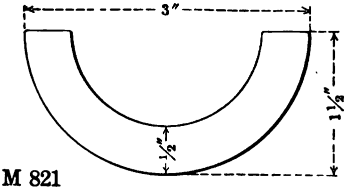


Section Index	Size		Thickness of Metal		Weight	
	Inches Flange Web Flange	Millimeters (Approximate)	Inch	m/m	Per Foot, Pounds	Per Meter Kilos
*Z 523	1½ x 2 x 1½	38 x 51 x 38	¼	6.35	3.75	5.58
*Z 520	1⅝ x 1¾ x 2	41 x 44 x 51	¼, ⅜, ¼	6.35 9.53 6.35	4.7	6.99
*Z 521	1⅝ x 1 11/16 x 2	41 x 43 x 51	¼, ⅜, 3/16	6.35 9.53 4.76	4.2	6.25
*Z 522	1½ x 1⅜ x 1½	38 x 35 x 38	5/16, ⅜, 5/16	7.94 9.53 7.94	4.2	6.25
*Z 511	35/64 x 7/16 x 35/64	14 x 11 x 14	5/32	3.97	0.63	0.94
*Z 512	0.388 x 0.35 x 0.529	9.9 x 8.9 x 13.5	0.127 0.130	3.23 3.30	0.44	0.6

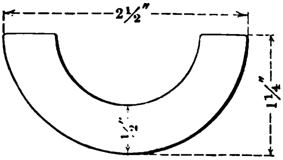
*Furnished only by special arrangement.

HOLLOW HALF ROUNDS

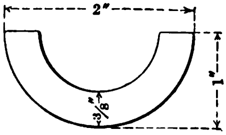
M 820



M 821

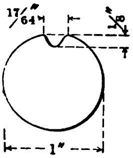


M 822

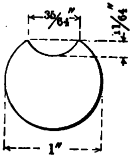


GROOVED ROUNDS

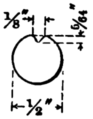
M 830



M 831



M 832



Section Index	Size		Weight	
	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos
M 820	3 x 1½	76 x 38	6.7	9.97
M 821	2½ x 1¼	63 x 32	5.3	7.89
M 822	2 x 1	51 x 25	3.25	4.84
M 830	1	25.40	2.60	3.87
M 831	1	25.40	2.45	3.64
M 832	½	12.70	.65	.96

SPECIAL STEEL SHAPES AND BARS

In addition to the sections shown in this catalogue, we can furnish a la number of special shapes rolled by the Carnegie and Illinois Steel Compan for manufacturing and other special purposes, for particulars of which see Shape Books and catalogues of those companies, which will be furnished request. Included in these Special Shapes are the following:

Angles, of various special shapes and sizes
Automobile Sections
Axle Beams
Axle Clip Sections
Axle Section

Baby Carriage Spring Steel
Beaded and Ribbed Tires
Beaded Bars
Beaded Hoop Bands
Beaded Hub Band
Beaded Nut Sections
Beaded Stove Leg Sections
Beams for various special purposes
Belt Rail Section
Beveled Corner Square Bars
Bevel Edge Clip
Bevel Edge Flats
Bevel Nose Sections
Bevel Shaft Sections
Bevel Wagon Box Sections
Bit Mouth Clip Sections
Blunt Ovals
Body Side Bearing Plate
Box Strap Sections
Brake Key Sections
B-Section
Buckle Bar Section

Cam Sections
Can Ring Sections
Car Door Trolley Track Section
Carline Section
Carrier Track Section
Chafe Section
Channeled Flats
Channel Rim Sections
Channels for various special purposes
Clamping Ring Section
Clincher Ring Sections
Clincher Tire Side Ring Sections

Clip Sections
Concave Convex Clip Sections
Concave Convex Hame Sections
Concave Convex Spring Section
Concord Hame Strap Sections
Cotton Gin Section
Coupling Sections
Crescent Hame Sections
Crescent Sections
Cultivator Beams
Cylinder Lag

Dash Channels
Demountable Rim Sections
Detachable Rim Sections
Diamond Harrow Tooth Sections
Draw Bar Key Section
Dresser Pipe Sections
Drill Point Steel
Drill Post Section
D-Section
Dual Felloe Bands

Elevator Tees

Farnham Third Rail Section
Felloe Bands
Fence Channels
Fence Post Section
Fender Channels
Figure 8 Section
Follower Plate
Friction Spring Section
Frog Filler Sections

Grooved Flats
Grooved Half Ovals
Grooved Hame Sections
Grooved Rounds
Grooved Tire Sections

SPECIAL STEEL SHAPES AND BARS.—*Continued*

val Clip Sections
vals
Sections
er Strap Section
r Bars
w Beams
w Channels
w Tooth Sections
Plate Sections
and Sections

lar Hexagon Section

ections

"B" Section
"D" Section
g Bars
g Ring Sections

eto Section
uard Channels

Yoke Sections
ections
teel Flats

e Angles

Bars
ections
er Tire Sections
Beams
ap Sections
ections
Machine Section
ing Press Sections
ction Strip Angle

Bar Section
Reinforcing Bars

Reach Angle
Rim Sections
Round Bevel Edge Bars
Round Toe Channel

Safety Ring Sections
Sash Sections
Saw Mill Track Sections
Screen Bar Section
Side Wall Section
Single Round Edge Bar
Slide Plates
Stanwood Back Section
Stanwood Front Section
Star Sections
Stove Leg Channels
Stove Leg Sections
Straight Side Tire Ring Section
Switch Friction Plates

Taper Angles
Thimble Section
Tire Channels
Tire Sections
Toe Calk Sections
Tongue Cap Sections
Track Angles
Track Chain Section
Trimmer Section
Trolley Track Sections

U-Bars

V-Bars
Vault Key Sections
Vehicle Spring Clip Sections
Vehicle Spring Steel
Velocipede Sections

Washboard Sections
Wedge Bars
Welder Bars
Wheel Rim Sections
Window Sections

FLAT ROLLED STEEL

ROUND EDGE SPRING STEEL

OVER-ALL MEASURE

¾" to 13/16" (19.05 to 20.64 m/m) wide x ⅛" to ½" (3.175 to 12.70 m/m).
⅞" to 1½" (22.23 to 38.10 m/m) wide x ⅛" to ¾" (3.175 to 19.05 m/m).
1 9/16" to 4" (39.69 to 101.60 m/m) wide x ¼" to 1" (6.35 to 25.40 m/m).
4⅛" to 7" (104.78 to 177.80 m/m) wide x ¼" to ½" (6.35 to 12.70 m/m).
Sizes not listed will be considered, if in sufficient quantities.

ROUND EDGE CONCAVE OR VEHICLE SPRING STEEL

OVER-ALL MEASURE

1" and 1 1/16" (25.4 and 26.99 m/m) wide x No. 6 to No. 00 B.W.G. (5.156 to 9.652 m/m).

1⅛" to 2" (28.57 to 50.80 m/m) wide x No. 7 to No. 00 B. W. G. (4.57 to 9.652 m/m).

2 1/16" to 2½" (52.39 to 63.50 m/m) wide x No. 7 B. W. G. to 7/16" (4.57 to 11.11 m/m).

2 9/16" to 3½" (65.09 to 88.90 m/m) wide x No. 6 B. W. G. to 7/16" (5.156 to 11.11 m/m).

Sizes not listed will be considered, if in sufficient quantities.

ROUND EDGE TOE CALK

⅜" to ⅞" (9.53 to 22.23 m/m) wide x 3/16" (4.76 m/m).
5/16" to ¾" (7.94 to 19.05 m/m) wide x ¼" (6.35 m/m).
⅜" to ¾" (9.53 to 19.05 m/m) wide x 5/16" (7.94 m/m).
7/16" to ⅞" (11.11 to 22.23 m/m) wide x ⅜" (9.53 m/m).
½" to ¾" (12.70 to 19.05 m/m) wide x 7/16" (11.11 m/m).
⅝" to ⅞" (15.88 to 22.23 m/m) wide x ½" (12.70 m/m).
¾" to ⅞" (19.05 to 22.23 m/m) wide x ⅝" (15.88 m/m).
The Over-all Measure is determined by adding to Face Measure:

1/16" (1.59 m/m) for sizes 3/16" (4.76 m/m), ¼" (6.35 m/m) and 5/16" (7.94 m/m) in thickness.

3/32" (2.38 m/m) for sizes ⅜" (9.53 m/m), 7/16" (11.11 m/m), ½" (12.70 m/m) and ⅝" (15.88 m/m) in thickness.

Sizes not listed will be considered, if in sufficient quantities.

ROUND EDGE BABY CARRIAGE SPRING STEEL

½" to 9/16" (12.70 to 14.29 m/m) wide x No. 13 B. W. G. to 3/16" (2.41 to 4.76 m/m).

⅝" to 1⅛" (15.88 to 28.58 m/m) wide x No. 13 B. W. G. to ¼" (2.41 to 6.35 m/m).

Sizes not listed will be considered, if in sufficient quantities.

SKELP

All sizes within the range of Sheared Plates (see pages 625 to 628), Universal Mill Plates (see page 629) and Band Edge Flats (see pages 174 and 175) can be furnished.

For tables of weights of bars see pages 143 and 144, and for weight per square foot see page 173.

WEIGHTS OF FLAT ROLLED STEEL

Thickness			Weight	
Inch		Millimeters	Pounds per Square Foot	Kilos per Square Meter
ractional	Decimal			
1/2	.5	12.70	20.4	99.601
15/32	.46875	11.91	19.125	93.376
7/16	.4375	11.11	17.85	87.151
13/32	.40625	10.32	16.575	80.926
3/8	.375	9.525	15.3	74.701
11/32	.34375	8.731	14.025	68.476
5/16	.3125	7.938	12.75	62.251
19/64	.296875	7.541	12.1125	59.138
9/32	.28125	7.144	11.475	56.026
17/64	.265625	6.747	10.8375	52.913
1/4	.25	6.350	10.2	49.801
15/64	.234375	5.953	9.5625	46.688
7/32	.21875	5.556	8.925	43.576
13/64	.203125	5.159	8.2875	40.463
3/16	.1875	4.763	7.65	37.350
11/64	.171875	4.366	7.0125	34.238
5/32	.15625	3.969	6.375	31.125
9/64	.140625	3.572	5.7375	28.013
1/8	.125	3.175	5.1	24.900
7/64	.109375	2.778	4.4625	21.788
3/32	.09375	2.381	3.825	18.675
5/64	.078125	1.984	3.1875	15.563
1/16	.0625	1.588	2.55	12.450
3/64	.046875	1.191	1.9125	9.338
1/32	.03125	.794	1.275	6.225
1/64	.015625	.397	0.6375	3.113
1/128	.0078125	.1984	0.31875	1.556
1/256	.00390625	.0992	0.159375	.778

For weights of steel plates thicker than ½ inch, see tables on pages 625 to 629. For weights of steel rolled to the Birmingham Wire Gauge (B. W. G.) numbers, see page 176.

STEEL HOOPS AND BANDS

Brand "Carnegie"

The following table gives the range of gauges in which we can fur various widths mentioned. The gauge numbers are those of the "Birn Wire Gauge" (B. W. G.). For their equivalents in decimals of an inc millimeters, and for comparison with the numbers of the "Birmingha and Hoop Iron Gauge" (B. G.), see table on page 177.

Widths		Thicknesses	
Inches	m/m	B. W. G.	m/n
3/8"	9.525	No. 18 to No. 4	1.245 to
7/16"	11.11	No. 19 to No. 4	1.067 to
1/2"	12.70	No. 22 to No. 4	.711 to
9/16" to 1"	14.29 to 25.40	No. 23 to No. 4	.635 to
1 1/16" to 2"	26.99 to 50.80	No. 22 to No. 4	.711 to
2 1/16" to 3"	52.39 to 76.20	No. 21 to No. 1	.812 to
3 1/16" to 3 1/2"	77.79 to 88.90	No. 20 to No. 1	.889 to
3 9/16" to 4"	90.49 to 101.60	No. 19 to No. 1	1.067 to
4 1/16" to 4 1/2"	103.19 to 114.30	No. 18 to No. 1	1.245 to
4 9/16" to 5 1/16"	115.89 to 128.59	No. 17 to No. 1	1.473 tc
5 1/8" to 6 3/4"	130.18 to 171.45	No. 16 to No. 1	1.651 to
6 13/16" to 8 5/8"	173.04 to 219.08	No. 14 to No. 1	2.108 to
8 11/16" to 9 5/8"	220.66 to 244.48	No. 12 to No. 1	2.769 tc
10 1/4"	260.35	No. 12 to No. 1	2.769 tc

From 3/8" (9.525 m/m) to 9 5/8" (244.48 m/m), intermediate widths can be furnish
Over 9 5/8" (244.48 m/m) in width, the size listed is the only one which is rolled, mediate widths will be considered.
For weights see following page.

STANDARD "ARROW" COTTON TIES

Standard "Arrow" Cotton Ties are supplied in bundles of 30 piece 6 inches (3½ meters) long, by 15/16" (23.8 m/m) wide, about No. 1 (B. W. G.) in thickness, with 30 buckles, dipped in cotton tie varni otherwise specified in the order. The bundles weigh about 45 lbs Kilos) each. If the ties are required to be furnished unvarnished, t should so state.

WEIGHTS OF STEEL HOOPS AND BANDS

Thickness B.W.G.	Width, Inches							
	½"	¾"	*1"	1¼"	1½"	2"	2½"	3"
	Pounds per Lineal Foot							
No. 1	.5100	.7650	1.0200	1.2750	1.5300	2.0400	2.5500	3.0600
" 2	.4828	.7242	.9656	1.2070	1.4484	1.9312	2.4140	2.8968
" 3	.4403	.6605	.8806	1.1008	1.3209	1.7612	2.2015	2.6418
" 4	.4046	.6069	.8092	1.0115	1.2138	1.6184	2.0230	2.4276
" 5	.3740	.5610	.7480	.9350	1.1220	1.4960	1.8700	2.2440
" 6	.3451	.5177	.6902	.8628	1.0353	1.3804	1.7255	2.0706
" 7	.3060	.4590	.6120	.7650	.9180	1.2240	1.5300	1.8360
" 8	.2805	.4208	.5610	.7013	.8415	1.1220	1.4025	1.6830
" 9	.2516	.3774	.5032	.6290	.7548	1.0064	1.2580	1.5096
" 10	.2278	.3417	.4556	.5695	.6834	.9112	1.1390	1.3668
" 11	.2040	.3060	.4080	.5100	.6120	.8160	1.0200	1.2240
" 12	.1853	.2780	.3706	.4633	.5559	.7412	.9265	1.1118
" 13	.1615	.2423	.3230	.4038	.4845	.6460	.8075	.9690
" 14	.1411	.2117	.2822	.3528	.4233	.5644	.7055	.8466
" 15	.1224	.1836	.2448	.3060	.3672	.4896	.6120	.7344
" 16	.1105	.1658	.2210	.2763	.3315	.4420	.5525	.6630
" 17	.0986	.1479	.1972	.2465	.2958	.3944	.4930	.5916
" 18	.0833	.1250	.1666	.2083	.2499	.3332	.4165	.4998
" 19	.0714	.1071	.1428	.1785	.2142	.2856	.3570	.4284
" 20	.0595	.0893	.1190	.1488	.1785	.2380	.2975	.3570
" 21	.0544	.0816	.1088	.1360	.1632	.2176	.2720	.3264
" 22	.0476	.0714	.0952	.1190	.1428	.1904	.2380	.2856
" 23	.0425	.0638	.0850	.1063	.1275	.1700	.2125	.2550
	Kilos per Lineal Meter							
No. 1	.759	1.138	1.518	1.897	2.277	3.036	3.795	4.554
" 2	.719	1.078	1.437	1.797	2.156	2.874	3.593	4.311
" 3	.655	.983	1.311	1.638	1.966	2.621	3.276	3.932
" 4	.602	.903	1.204	1.505	1.806	2.408	3.011	3.613
" 5	.557	.835	1.113	1.392	1.670	2.226	2.783	3.339
" 6	.514	.771	1.027	1.284	1.541	2.054	2.568	3.081
" 7	.455	.683	.911	1.138	1.366	1.822	2.277	2.732
" 8	.417	.626	.835	1.044	1.252	1.670	2.087	2.505
" 9	.374	.562	.749	.936	1.123	1.498	1.872	2.247
" 10	.339	.509	.678	.848	1.017	1.356	1.695	2.034
" 11	.304	.456	.607	.759	.911	1.215	1.518	1.822
" 12	.276	.414	.552	.690	.827	1.104	1.379	1.655
" 13	.240	.361	.481	.601	.721	.961	1.202	1.442
" 14	.210	.315	.420	.525	.630	.840	1.050	1.260
" 15	.182	.273	.364	.455	.547	.729	.911	1.093
" 16	.164	.247	.329	.411	.493	.658	.822	0.987
" 17	.147	.220	.293	.367	.440	.587	.734	0.880
" 18	.124	.186	.248	.310	.372	.496	.620	0.744
" 19	.106	.160	.213	.266	.319	.425	.531	0.638
" 20	.089	.133	.177	.221	.266	.354	.443	0.531
" 21	.081	.121	.162	.202	.243	.324	.405	0.486
" 22	.071	.106	.142	.177	.213	.283	.354	0.425
" 23	.063	.095	.126	.158	.190	.253	.316	0.379

*To ascertain the weight of widths not included in above table, take the figures shown for 1 inch wide and multiply them by the width in inches. Example: 2¼" wide x No. 20 B. W. G., 0.119 x 2¼ = 0.2678 lbs. per foot, and 0.177 x 2¼ = 0.398 kilos per meter.

BIRMINGHAM WIRE GAUGE ("B. W. G.")

Equivalents in Inches and Millimeters and Corresponding Wei of Flat Rolled Steel

Gauge Number	Thickness		Weight	
	Inch	m/m	Pounds per Sq. Ft.	Kilos per Square Mete
0000	.454	11.532	18.5232	90.438
000	.425	10.795	17.34	84.661
00	.380	9.652	15.504	75.697
0	.340	8.636	13.872	67.729
1	.300	7.620	12.24	59.761
2	.284	7.213	11.5872	56.573
3	.259	6.579	10.5672	51.593
4	.238	6.045	9.7104	47.410
5	.220	5.588	8.976	43.824
6	.203	5.156	8.2824	40.438
7	.180	4.572	7.344	35.856
8	.165	4.191	6.732	32.868
9	.148	3.759	6.0384	29.482
10	.134	3.404	5.4672	26.693
11	.120	3.048	4.896	23.904
12	.109	2.769	4.4472	21.713
13	.095	2.413	3.876	18.924
14	.083	2.108	3.3864	16.534
15	.072	1.829	2.9376	14.343
16	.065	1.651	2.652	12.948
17	.058	1.473	2.3664	11.554
18	.049	1.245	1.9992	9.761
19	.042	1.067	1.7136	8.366
20	.035	.889	1.428	6.972
21	.032	.813	1.3056	6.375
22	.028	.711	1.1424	5.577
23	.025	.635	1.02	4.980
24	.022	.559	0.8976	4.382
25	.020	.508	0.816	3.984
26	.018	.457	0.7344	3.586
27	.016	.406	0.6528	3.187
28	.014	.356	0.5712	2.789
29	.013	.330	0.5304	2.590
30	.012	.305	0.4896	2.390
31	.010	.254	0.408	1.992
32	.009	.229	0.3672	1.793
33	.008	.203	0.3264	1.594
34	.007	.178	0.2856	1.394
35	.005	.127	0.2040	0.996
36	004	.102	0.1632	0.797

NDARD GAUGES FOR STEEL PLATES, SHEETS AND HOOPS

parative table showing the thickness in decimals of an inch and in millimeters of the numbers of
he "UNITED STATES STANDARD GAUGE for SHEET and PLATE IRON and STEEL" (U. S. G.)
The "BIRMINGHAM WIRE GAUGE" also known as "STUB'S IRON WIRE GAUGE" (B. W. G.)
and
The "BIRMINGHAM SHEET and HOOP IRON GAUGE" (B. G.)

Thickness in Decimals of an Inch				Thickness in Millimeters			
umber Gauge	U. S. G.*	B. W. G.	B. G.	Number of Gauge	U. S. G.*	B. W. G.	B. G.
0000000	.5			0000000	12.70		
000000	.46875			000000	11.91		
00000	.4375			00000	11.11		
0000	.40625	.454		0000	10.32	11.532	
000	.375	.425	.5000	000	9.53	10.795	12.700
00	.34375	.380	.4452	00	8.73	9.652	11.308
0	.3125	.340	.3964	0	7.94	8.636	10.068
1	.28125	.300	.3532	1	7.14	7.620	8.971
2	.265625	.284	.3147	2	6.75	7.213	7.993
3	.25	.259	.2804	3	6.35	6.579	7.122
4	.234375	.238	.2500	4	5.95	6.045	6.350
5	.21875	.220	.2225	5	5.56	5.588	5.651
6	.203125	.203	.1981	6	5.16	5.156	5.032
7	.1875	.180	.1764	7	4.76	4.572	4.480
8	.171875	.165	.1570	8	4.37	4.191	3.988
9	.15625	.148	.1398	9	3.97	3.759	3.551
10	.140625	.134	.1250	10	3.57	3.404	3.175
11	.125	.120	.1113	11	3.18	3.048	2.827
12	.109375	.109	.0991	12	2.78	2.769	2.517
13	.09375	.095	.0882	13	2.38	2.413	2.240
14	.078125	.083	.0785	14	1.98	2.108	1.994
15	.0703125	.072	.0699	15	1.79	1.829	1.775
16	.0625	.065	.0625	16	1.59	1.651	1.587
17	.05625	.058	.0556	17	1.43	1.473	1.412
18	.05	.049	.0495	18	1.27	1.245	1.257
19	.04375	.042	.0440	19	1.11	1.067	1.118
20	.0375	.035	.0392	20	0.953	.8890	.996
21	.034375	.032	.0349	21	0.873	.8128	.886
22	.03125	.028	.03125	22	0.794	.7112	.794
23	.028125	.025	.02782	23	0.714	.6350	.707
24	.025	.022	.02476	24	0.635	.5588	.629
25	.021875	.020	.02204	25	0.556	.5080	.560
26	.01875	.018	.01961	26	0.476	.4572	.498
27	.0171875	.016	.01745	27	0.437	.4064	.4432
28	.015625	.014	.015625	28	0.397	.3556	.3969
29	.0140625	.013	.0139	29	0.357	.3302	.3531
30	.0125	.012	.0123	30	0.318	.3048	.3124
31	.0109375	.010	.0110	31	0.278	.2540	.2794
32	.01015625	.009	.0098	32	0.258	.2286	.2489
33	.009375	.008	.0087	33	0.238	.2032	.2210
34	.00859375	.007	.0077	34	0.218	.1778	.1956
35	.0078125	.005	.0069	35	0.198	.1270	.1753
36	.00703125	.004	.0061	36	0.179	.1016	.1549
37	.006640625		.0054	37	0.169		.1371
38	.00625		.0048	38	0.159		.1219

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*The thicknesses *of the U. S. G. numbers given* in the above table are approximate, being *oretical. The U. S. Gauge is a weight gauge,* based on the weight per square foot. For *ther particulars, see page 178.*

UNITED STATES STANDARD GAUGE ("U. S. G.") FOR SHEET AND PLATE IRON AND STEEL

Adopted as Standard by American Railway Master Mechanics' Association and Association of American Steel Manufacturers

Number of Gauge U. S. G.	Approximate Thickness			Weight per Square Foot, Ounces, Avoirdupois	Weight per Square Foot, Pounds, Avoirdupois	Weight per Square Meter, Kilograms
	Fractions of an Inch	Decimals of an Inch	Millimeters			
0000000	1/2	.5	12.7	320	20.00	97.65
000000	15/32	.46875	11.90625	300	18.75	91.55
00000	7/16	.4375	11.1125	280	17.50	85.44
0000	13/32	.40625	10.31875	260	16.25	79.33
000	3/8	.375	9.525	240	15.00	73.24
00	11/32	.34375	8.73125	220	13.75	67.13
0	5/16	.3125	7.9375	200	12.50	61.03
1	9/32	.28125	7.14375	180	11.25	54.93
2	17/64	.265625	6.746875	170	10.625	51.88
3	1/4	.25	6.35	160	10.00	48.82
4	15/64	.234375	5.953125	150	9.375	45.77
5	7/32	.21875	5.55625	140	8.75	42.72
6	13/64	.203125	5.159375	130	8.125	39.67
7	3/16	.1875	4.7625	120	7.50	36.62
8	11/64	.171875	4.365625	110	6.875	33.57
9	5/32	.15625	3.96875	100	6.25	30.52
10	9/64	.140625	3.571875	90	5.625	27.46
11	1/8	.125	3.175	80	5.00	24.41
12	7/64	.109375	2.778125	70	4.375	21.36
13	3/32	.09375	2.38125	60	3.75	18.31
14	5/64	.078125	1.984375	50	3.125	15.26
15	9/128	.0703125	1.7859375	45	2.8125	13.73
16	1/16	.0625	1.5875	40	2.50	12.21
17	9/160	.05626	1.42875	36	2.25	10.99
18	1/20	.05	1.27	32	2.00	9.765
19	7/160	.04375	1.11125	28	1.75	8.544
20	3/80	.0375	.9525	24	1.50	7.324
21	11/320	.034375	.873125	22	1.375	6.713
22	1/32	.03125	.793750	20	1.25	6.103
23	9/320	.028125	.714375	18	1.125	5.493
24	1/40	.025	.635	16	1.00	4.882
25	7/320	.021875	.555625	14	.875	4.272
26	3/160	.01875	.47625	12	.75	3.662
27	11/640	.0171875	.4365625	11	.6875	3.357
28	1/64	.015625	.396875	10	.625	3.052
29	9/640	.0140625	.3571875	9	.5625	2.746
30	1/80	.0125	.3175	8	.50	2.441
31	7/640	.0109375	.2778125	7	.4375	2.136
32	13/1280	.01015625	.25796875	6½	.40625	1.983
33	3/320	.009375	.238125	6	.375	1.831
34	11/1280	.00859375	.21828125	5½	.34375	1.678
35	5/640	.0078125	.1984375	5	.3125	1.526
36	9/1280	.00703125	.17859375	4½	.28125	1.373
37	17/2560	.006640525	.168671875	4¼	.265625	1.297
38	1/160	.00625	.15875	4	.25	1.221

The United States Standard Gauge is a weight gauge based upon the weights per square foot in ounces avoirdupois and approximate thickness based upon 480 pounds per cubic foot.

In the practical use and application of the United States Standard Gauge, a weight variation of 2½ per cent. either way may be allowed.

LVANIZED PLAIN SHEETS "APOLLO" BRAND

APOLLO

→ FROM ←

UNITED STATES STEEL PRODUCTS COMPANY NEW YORK, U.S.A.

APOLLO" Plain Galvanized Sheets are of king-up quality, heavily coated, and their finish and smoothness are already well They are true to gauge, uniform in working and trustworthy in every respect; will eam and stand any reasonable working test.

ollo" Galvanized

Standard Gauges: Nos. 10, 12, 14, 16, 18, 20, 22, 24, 26, 27, 28, 29 and 30 Gauge.

Standard Widths: 24, 26, 28, 30 and 36 inches. (61, 66, 71, 76 and 91 centimeters.)

Standard Lengths: 72, 84, 96 and 120 inches. (1.83, 2.13, 2.44 and 3.05 meters.)

Also 1 meter wide by 2 meters long.

Other gauges, widths and lengths specially manufactured to order.

Packing.—In bundles; in skeleton cases, either unlined or felt lined, and in close cases, either unlined or felt lined; cases to contain either 5 cwt. (254 kilos) or 10 cwt. (508 kilos) as desired.

CORRUGATED GALVANIZED SHEETS

Regular Lengths.—5, 6, 7, 8, 9 and
(1.52, 1.83, 2.13, 2.44, 2.74 and 3.05 n
In some styles we can also furnish
12 ft. lengths (3.35 and 3.66 meters).

Usual Widths.—Eight 3-inch (8/3
rugations, 26″ (66 centimeters) wide;
3-inch (10/3″) corrugations, 32″ (82
meters) wide.

Regular Gauge Numbers.—16, 18,
24, 26, 27, 28, 29 and 30.

Corrugations.—The recognized st
pattern for roofing has 3-inch corrug
We can also furnish 5″, 2½″ and 2
63½ and 51 m/m) corrugations
regular gauges; 1¼″ (32 m/m) corrug
in gauges No. 20 and lighter; 1″, ⅝
$\frac{3}{16}$″ (25, 16 and 4.76 m/m) corrug
in gauges No. 24 and lighter.

Packing.—We pack Corrugated Sh
bundles, usually of about 150 lbs. (70
or 2 cwt. (100 kilos); in skeleton
either unlined or felt lined and in
cases, either unlined or felt lined; ca
contain either 5 cwt. (254 kilos) or 10 cwt. (508 kilos), as desired.

PAINTED CORRUGATED SHEETS

We are prepared to furnish Painted Corrugated Roofing Sheets in th
gauges, widths, lengths, styles of corrugations, etc., as Galvanized.
sheets are usually painted with Metallic red or brown paint, which has
to be very satisfactory, but we can also supply them painted with Re
or Black Graphite paint.

APOLLO
—FROM—
UNITED STATES STEEL
PRODUCTS COMPANY
NEW YORK, U.S.A.

CORRUGATED GALVANIZED SHEETS

"APOLLO" BRAND

ximate number of sheets per ton of 2240 pounds (1016 kilos).

(Count not guaranteed.)

	6 Ft.	7 Ft.	8 Ft.	9 Ft.	10 Ft.
x 8/3" Corg.	240	206	180	160	144
x 10/3" "	194	167	146	129	116
x 8/3" "	220	189	165	146	132
x 10/3" "	180	154	135	120	108
x 8/3" "	200	172	150	133	120
x 10/3" "	167	143	125	111	100
x 8/3" "	186	159	139	124	111
x 10/3" "	155	133	116	103	93
x 8/3" "	140	120	105	93	84
x 10/3" "	117	100	88	78	70
x 8/3" "	116	99	87	77	69
x 10/3" "	97	83	73	65	58
x 8/3" "	95	81	71	63	57
x 10/3" "	79	68	59	53	47
x 8/3" "	72	62	54	48	43
x 10/3" "	62	53	46	41	37

PLAIN GALVANIZED SHEETS

roximate number of sheets per ton is the same for plain galvanized
ches (76 cm.) wide as for corrugated sheets with 8/3" corrugations,
ain galvanized sheets 36 inches (914 m/m) wide the same as for
ugations, for which see above table.

APOLLO

KEYSTONE

→FROM←
UNITED STATES STEEL
PRODUCTS COMPANY
NEW YORK, U.S.A.

COPPER STEEL SHEETS

BLACK AND GALVANIZED PLAIN AND CORRUGATED

THE HIGHEST GRADE OF SHEETS MADE

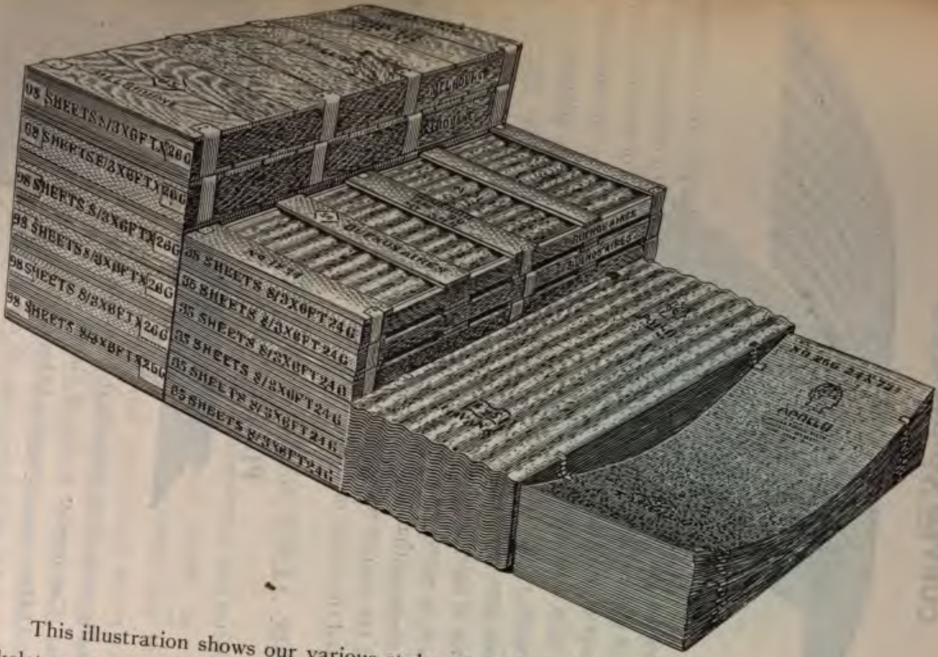
After several years of careful study and effort on the part of the chemists, metallurgists and operating officials of the American Sheet and Tin Plate Company, during which time careful tests were made to establish the comparative corrosion resisting values of iron sheets, steel sheets, and copper steel sheets, we are now prepared to offer a product to such of our customers as require a particularly durable sheet. This product galvanized is our APOLLO-KEYSTONE COPPER STEEL SHEET. We furnish this material both black and galvanized—either plain or corrugated.

Covering a period of about ten years, the most thorough tests have been made: Bare steel sheets (not galvanized) of this KEYSTONE COPPER STEEL grade have been exposed to the weather alongside other steel and iron sheets, and the results have been so highly favorable to the copper steel sheets that we have no hesitation in offering these sheets with entire confidence in the satisfaction they will give.

A full description of these tests is given in a separate pamphlet, which will be mailed upon request.

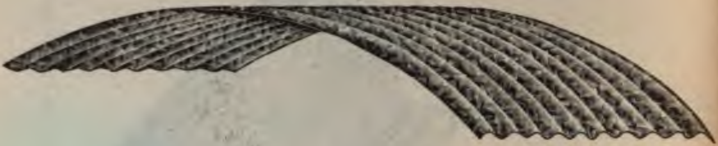
Not only do these APOLLO-KEYSTONE COPPER STEEL SHEETS contain copper in the proper proportion to reduce corrosion to a minimum, but the greatest care is also exercised throughout the manufacturing process of rolling, re-rolling, heating and annealing to produce sheets of the highest quality.

We are prepared to furnish these sheets in the same gauges, widths, lengths and packing as apply to our ordinary black sheets and APOLLO galvanized sheets, described on pages 179 to 181, 183 to 186, and 188.



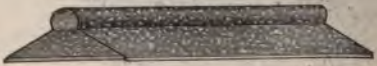
This illustration shows our various styles of packing sheets for export—in close cases, skeleton cases and bundles.

CURVED CORRUGATED SHEETS



If so desired, we will furnish, for a small extra charge, our Corrugated Sheets in all gauges curved to any reasonable radius in such a manner that they may be used as arches between beams, or as awnings, roofs or for any purpose requiring such a product. The curved corrugations give to the material unusual strength, combined with lightness, making it admirably adapted for use where these two qualities are essential or desirable. It is also very durable when made of galvanized sheets or protected in any way from corrosion. In ordering, it is necessary that the buyer specify whether it is for interior or exterior work, so that we may arrange the corrugations in such a manner as to fulfill the requirements with the least possible waste for laps: the base length and the radius or rise of the arc should also be given.

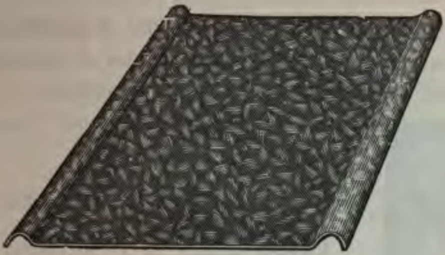
PLAIN RIDGE ROLL



Usually made from galvanized sheets, although can furnish also of painted sheets. Can furnish in No. 18 Gauge and lighter and in any length up to 10 ft. (3.048m); usual length is either 6 ft. or 8 ft. (1.829m or 2.438m). Standard girth is 15″ (381 m/m), but we can also supply 18″, 20″, 24″ (457, 508, 610 m/m) or otherwise as required. Will pack in bundles or in skeleton crates as required.

We are also prepared to furnish other patterns of Ridging when required.

ROOFING TILES



lvanized Roofing Tiles are popular in some markets, are of attractive
arance, and make an excellent roofing. We usually furnish this material
o. 24 gauge or lighter, 24 in. (610 m/m) center to center of side corruga-
or crimps. Standard length is 3 ft. (0.915m), but we are prepared to
ish lengths up to 10 ft. (3.048m). Shipped either in bundles or in skele-
rates, as required.

EYSTONE HAMMERED POLISHED STEEL SHEETS

Exactly similar in appearance and surface finish to the product heretofore known as "Wood's Patent Planished Iron"—it differs only in that it has a copper steel base; these sheets are more malleable and more rust-resistant. We have discontinued the manufacture of Planished Iron and offer Hammered Polished as a substitute. We can supply it in gauges Nos. 18 to 28 inclusive, in sizes up to 32" x 96" (0.813m x 2.438m). Manufacturers of high grade sheet metal goods find it specially adapted for many purposes.

BLACK SHEET STEEL

These sheets are made from steel specially suitable for manufactu purposes and in various qualities adapted for the particular purposes for w they are intended. They represent the highest standards and best qu obtainable through the use of the highest grades of material, skilled l modern equipment, and the most approved mill practice.

Our standard product is

EAGLE Brand STEEL SHEETS.

Gauges No. 30 to 17 inclusive, are cold r and close annealed.

Gauges No. 16 to ¼ inch inclusive, are annealed.

Standard lengths: 60, 72, 84, 96 and 120 in (1.52, 1.83, 2.13, 2.44 and 3.05 meters).

Standard widths: 24, 30 and 36 inches (61, 76 and 91 centimeters).

Other widths and lengths specially manufactured to order.

These sheets will be supplied in either Bessemer or Open Hearth (equal to Siemens-Martin) Steel.

WELLSVILLE POLISHED SHEETS

KEYSTONE COPPER STEEL

A handsome dark blue polished product, specially adapted for high class stoves, ranges, stove pipes, elbows, etc.

It enjoys an enviable reputation for retaining its original handsome blue color after long periods of continuous or intermittent heating.

ELECTRICAL SHEETS

Special Sheets to meet the requirements of
Electrical Machinery Manufacturers

APOLLO SPECIAL ELECTRICAL

PATENTED

HIGH SILICON ALLOY SHEETS

Minimum Iron Loss—Non-aging—specially adapted for
Transformer Construction.

Reduces Core Loss and Heating;

Increases Efficiency.

DYNAMO SPECIAL ELECTRICAL SHEETS

PATENTED

SILICON ALLOY SHEETS

Specially developed for
Highest efficiency Dynamo and Motor work

Particularly suitable for
Stators of alternating current motors

Non-aging Low Iron Losses

U. S. ELECTRICAL

Highest Quality Sheets for Dynamo and
Motor Construction

Practically Non-aging.

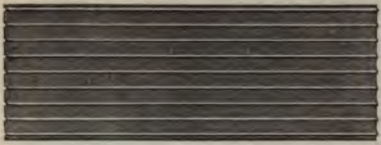
AMERICAN ARMATURE SHEETS

Good grade sheets suitable for Laminated Poles,
Slow Speed and Intermittent Operating Machines

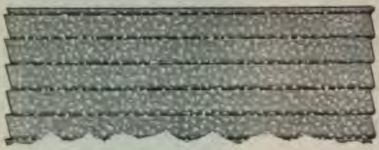
POLE FACE STOCK

High permeability sheets for Laminated Poles

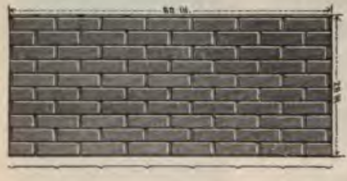
SHEET METAL SIDING



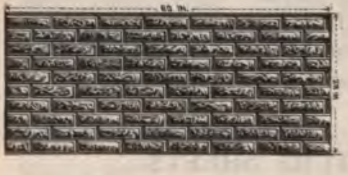
Beaded Ceiling or Siding. Usually made from galvanized sheets, although can supply from painted sheets if preferred. Can supply this pattern in No. 24 gauge and lighter. The usual covering width of sheets is 24″ (610 m/m) and the standard lengths 5, 6, 7, 8, 9 and 10 ft. (1.524m, 1.829m, 2.134m, 2.438m, 2.743m and 3.048m). The beads or crimps shown in the illustration are spaced 3″ (76 m/m) apart, center to center.



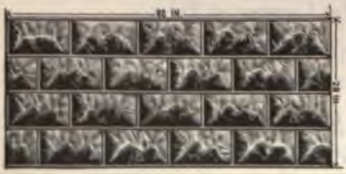
Weatherboard Siding.—Usually made from galvanized sheets, although can supply from painted sheets if preferred. Can supply this pattern in No. 24 gauge and lighter. The usual covering width of sheets is 24″ (610 m/m) and the standard lengths, 5, 6, 7, 8, 9 and 10 ft. (1.524m, 1.829m, 2.134m, 2.438m, 2.743m and 3.048m). The formed sheet has six 4-inch (102 m/m) faces and ½-inch (12.7 m/m) depth.



Plain Brick Siding.—Furnished in either galvanized or painted sheets of No. 26 gauge and lighter. Standard size of sheet is 28″x60″ (0.711 m x 1.524 m) and the size of each individual brick is 2⅘″ x 8¼″ (71 x 210 m/m). Can be shipped in bundles if desired, but preferably in skeleton crates to protect in transit.

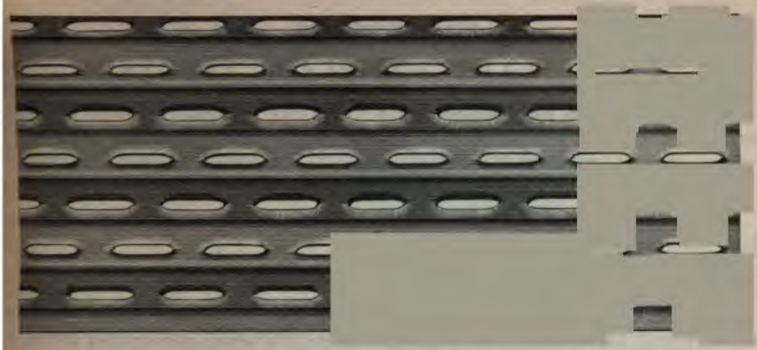


Rock Face Brick Siding.—Furnished in either galvanized or painted sheets of No. 26 gauge and lighter. Standard size of sheet is 28″x60″ (0.711m x 1.524m) and the size of each individual brick is 2⅘″ x 8¼″ (71 x 210 m/m). Can ship in bundles if desired, but preferably in skeleton crates to protect in transit.



Rock Face Stone Siding.—Furnished in either galvanized or painted sheets of No. 26 gauge and lighter. Standard size of sheet is 28″ x 60″ (0.711m x 1.524m) and the size of each individual stone is 7″ x 12″ (178 x 305 m/m). Can ship in bundles if desired, but preferably in skeleton crates to protect in transit.

CAMBRIDGE RIGID REVERSIBLE METAL LATH



Standard size, 24 x 96 inches (0.610m x 2.438m).

Gauges Nos. 27, 28 and 29.

In building construction, Metal Lath has rapidly supplanted wooden lath, hingles and weatherboard siding, because it is vermin proof, sound proof, damp proof and crack proof.

Buildings and rooms in which Metal Lath has been used are much cooler n summer and warmer in winter than those of the usual frame or stone construction. Therefore, in the building of churches, warehouses, stables, factoies and other large buildings, Metal Lath is becoming quite popular. It is lso used to great advantage for stoops, archways, porticos, vestibules, corices and fountain basins, and, when covered with a coat of plaster or cement, s indestructible.

The above form being reversible, plastering can be applied to either side, r, in solid partitions, on both sides. As the apertures are wedge shaped, the mortar key is perfect. Flanges increase the rigidity of this Lath, a very mportant feature. Flanges also prevent mortar from falling down the back r face when being applied, and at the same time furnish a gauge for the thickess of the first coat, thus saving 10 to 20% in mortar. This Lath is easily pplied to wood or iron framework, can be formed to fit any angle or curve, nd is extensively used in buildings where saving of floor space is desired and here fire proof construction is essential. It is the only Lath specially adaptd to outside construction, and when plastered with cement, makes a fine subitute for stone.

TIN MILL PRODUCTS

BLACK PLATES AND BLACK TAGGERS

Made on tin mills, from BESSEMER or OPEN HEARTH Steel. Suitable for tinning, or for other purposes requiring plates with a clean surface.

Gauge limits—16 to 38 U. S. G., inclusive (see table on page 178).

Size limits—10 x 10 to 32 x 48 (254 x 254 to 813 x 1219 m/m).

Tin Mill Black Plate is furnished for special purposes under the following descriptions:

BLACK PLATE FOR TINNING

All gauges, pickled, annealed, cold rolled and reannealed finish. Under this heading, No. 36 and No. 38 gauge material is sometimes called BLACK TAGGERS.

BLACK PLATE FOR STAMPING AND ENAMELING

(Designated as ENAMELING STOCK)

Bessemer or Open Hearth (including Keystone Copper Steel if desired, which we strongly recommend for deep drawing), pickled and annealed special finish.

Gauges—Nos. 16 to 30 U. S. G., inclusive.

Sizes—preferably in squares 10x10 to 28x28 inches (254x254 to 712x712 m/m).

BLACK PLATE FOR CEILINGS

Bessemer or Open Hearth, hot-rolled, one pass cold rolled and annealed soft.

Gauges—28 and 30 U. S. G.

Sizes—20x20 to 24x48 inches (508x508 to 610x1219 m/m), inclusive.

BLACK TRUNK SHEETS

Bessemer, one pass cold-rolled finish. Not embossed or decorated.

Gauges—30, 32 and 34 U. S. G.

Sizes—20″x28″, 20″x36″ and 20″x40″ (508x712, 508x914 and 508x1016 m/m).

BLUED ELBOW STOCK

Bessemer or Open Hearth, uniform color.

Gauges—28, 29 and 30 U. S. G.

Sizes—Preferably in sheets of the correct size for making one elbow.

Packed for export shipment in metal boxes.

TIN MILL BLACK PLATES.—*Continued*

BLUED STOVE PIPE STOCK

Bessemer, uniform color and polished. Exclusively for stove pipe.
Gauges—28, 29 and 30, U. S. G.
Sizes—preferably in sheets of the correct size for making one length of pipe.
Packed for export shipment in metal boxes.

BLACK CANADA PLATES

Bessemer quality. Standard size, 18 x 24 inches (457 x 610 m/m). In bundles containing 52, 60, 75 or 85 sheets, weighing 112 lbs. (50.8 kilos).

TIN MILL BLUE

CAMBRIDGE BLUE

MORTON POLISHED

PACKING.—Tin Mill Black Plates are easily affected by moisture. It is herefore recommended that for ocean shipment either metal boxes or tin ned wooden boxes be used. The latter are sealed, and will thoroughly pro- ct material from water and dampness.

It is recommended that Tin Mill Black Plates be ordered in sizes ranging om 14″ x 20″ to 20″ x 28″ (355 x 508 to 508 x 712 m/m), to facilitate packing boxes or bundles, the weight of which will permit of handling with least ssible breakage.

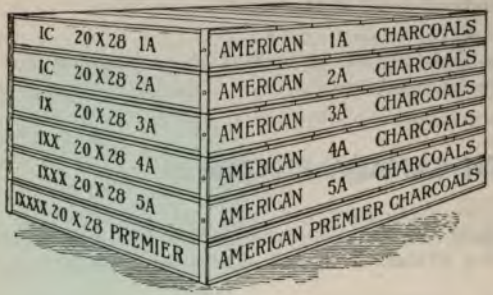
GALVANIZED CANADA PLATES

Of the very highest quality. Made from best raw materials by latest proved methods. True to gauge and uniform in quality. Size—18″ x 24″ 7 x 610 m/m), 52, 60, 75 and 85 sheets, to weigh 112 lbs. (50.8 kilos).

Packed for shipment in bundles or in wooden boxes.

TIN PLATES

Our Standard Grades of "AMERICAN" Tin Plates are as follows:



American Cokes,
American Best Cokes,
American "A" Charcoals,
American "AA" Charcoals,
American "AAA" Charcoals,
American "AAAA" Charcoals,
American "AAAAA" Charcoals,
Premier Charcoals.

The base of these plates is best soft steel, either Bessemer or Open Hearth quality, made specially for tin plating purposes. The names "Cokes" and "Charcoals" are trade terms, which indicate the finish, plates with lighter coating being designated as "Cokes" and those with heavier coating as "Charcoals". Each "A" signifies an additional amount of coating. "Taggers" is a trade name for No. 36 and No. 38 Gauge material.

American Coke Tin Plate is used generally throughout the world in the manufacture of Cans for packing fruits, vegetables, fish and meat products, also for packages to contain tea, coffee, spices and tobacco. When fruit, such as pineapples containing an excessive amount of acid, is to be packed, we recommend using Tin Plate having a base of Keystone Copper Steel. Numerous experiments, backed by several years' experience of various packers, have demonstrated beyond a doubt that the use of this will positively reduce losses from perforations or pinholing to a minimum.

TIN PLATES.—*Continued*

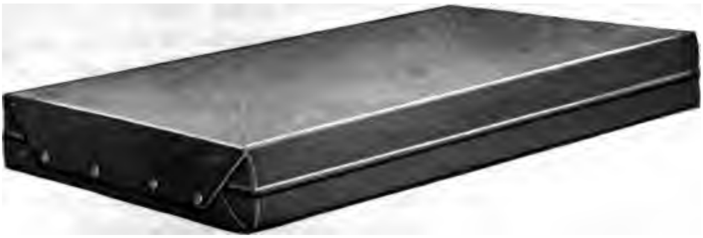
PACKING

The usual manner of packing tin plates is in light wooden boxes and when quired for ocean shipment the wooden boxes are strapped; usually with ll length straps around the box the long way. Too much attention cannot e given the feature of packing. Customers should be fully advised as to he various styles of packing which we can furnish, and should be requested o indicate definite packing instructions on all orders.

The standard wooden box is hardly suited for rough handling in and out of essels or lighters and we therefore recommend either TIN LINED WOODEN BOXES or SHEET METAL BOXES for ocean shipment.

Tin-lined wooden boxes are best suited for protecting tin plates from sea water or moisture of any kind as they are tightly soldered, thus not only protecting the contents while en route but the shipment can be safely stored on arrival at destination. It must be remembered that some of the edges of sheets are raw steel and will rust very easily.

SHEET METAL BOXES are made of black steel sheets either formed over a wood frame similar to the frame of the standard wooden box or, as has been more recently developed, are made by joining the top and bottom sheets along the sides by a folded seam, machine made, which forms an envelope into which the tinplate is inserted at one end. After the box or envelope has been filled the ends are folded in tightly and nailed fast to pieces of wood inserted for that purpose. These boxes are designed to prevent breakage from handling. They are not water tight and are therefore intended to take the place of the old style wooden box rather than the tin-lined wooden box.



TIN PLATES.—*Continued*

STANDARD WEIGHTS AND SIZES

Trade Name	Size		Number of Sheets per Box	Net Weight per Box		Gross Weight per Box	
	Inches	m/m		Lbs.	Kilos	Lbs.	Kilos
38 Ga. 55 lbs.	14x20	355x508	112	55	24.95	60	27.22
36 Ga. 65 lbs.	14x20	355x508	112	65	29.48	70	31.75
70 lbs.	14x20	355x508	112	70	31.75	75	34.02
75 lbs.	14x20	355x508	112	75	34.02	80	36.29
80 lbs.	14x20	355x508	112	80	36.29	85	38.55
85 lbs.	14x20	355x508	112	85	38.55	90	40.82
90 lbs.	14x20	355x508	112	90	40.82	95	43.10
95 lbs.	14x20	355x508	112	95	43.10	101	45.81
100 lbs.	14x20	355x508	112	100	45.36	106	48.08
IC 107 lbs.	14x20	355x508	112	107	48.53	113	51.25
IX 135 lbs.	14x20	355x508	112	135	61.23	142	64.41
IXX 155 lbs.	14x20	355x508	112	155	70.31	163	73.94
IXXX 175 lbs.	14x20	355x508	112	175	79.38	184	83.46
IXXXX 195 lbs.	14x20	355x508	112	195	88.45	204	92.53
IC 107 lbs.	14x18¾	355x476	124	110	49.90	116	52.62
IC 107 lbs.	10x20	254x508	225	153	69.40	163	73.94

A BASE BOX on which BASE prices are quoted consists of 112 sheets 14x20″ size and a base price is supplied for each weight. The thickness is usually designated by giving the net weight of a base box as in the above list and is spoken of as "basis weight".

BASE PRICES: We prefer to quote base prices on Coke and Charcoal tin plates except in weights that are sold by the pound. Plates will be invoiced at prices per box or package. To obtain price per box or package, find ratio of surface inches which such package contains as compared with base box and multiply such ratio by the base price. For example, when the base price is $4.00 and the price for a package containing 112 sheets of 14x22″ is wanted, multiply the ratio for this size 1.10 by the base price $4.00, the result will be $4.40, the correct price per package. In the same way the net weight of the package can be obtained by multiplying the ratio by the base weight.

AMERICAN TERNE OR ROOFING PLATES

AMERICAN OLD STYLE A 20 LBS. CTG. IC S&RS
AMERICAN OLD STYLE AA 25 LBS. CTG. IC S&RS
AMERICAN OLD STYLE AAA 30 LBS. CTG. IC S&RS
AMERICAN OLD STYLE AAAA 35 LBS. CTG. IC S&RS
AMERICAN OLD STYLE AAAAA 40 LBS. CTG. IC S&RS
OIL FINISH
OIL FINISH
OIL FINISH
OIL FINISH
OIL FINISH

rne Plate sometimes called Roofing Tin is made from best quality soft Hearth copper bearing steel, coated with a mixture consisting of tin and which experience has shown will best withstand the action of the her. The amount of coating carried varies according to the brand, as ated in the list below and the quantity stated is per box of 112 sheets 28″.

nerican Terne Plates are supplied with "Dark Oil" or "Bright Dry" h, in I. C. 107 lb. or I. X. 135 lb. thickness.

zes—14 x 20 and 20 x 28 inches (355 x 508 and 508 x 712 m/m).

AMERICAN TERNES—100 lbs. basis.
8 lbs. coating. Stamped.

MERICAN
IC
JNDS COATING

AMERICAN TERNES—IC 107 lbs. basis.
8 lbs. coating. Stamped.

AMERICAN
EXTRA
UNDS COATING

AMERICAN EXTRA TERNES—
12 lbs. coating. Stamped.

MERICAN
SPECIAL
UNDS COATING

AMERICAN SPECIAL TERNES—
15 lbs. coating. Stamped.

CAN OLD STYLE
A
UNDS COATING

AMERICAN OLD STYLE "A" TERNES—
20 lbs. coating. Resquared and stamped.

CAN OLD STYLE
AA
UNDS COATING

AMERICAN OLD STYLE "AA" TERNES—
25 lbs. coating. Resquared and stamped.

AN OLD STYLE
AAA
UNDS COATING

AMERICAN OLD STYLE "AAA" TERNES—
30 lbs. coating. Resquared and stamped.

AMERICAN TERNE OR ROOFING PLATES.—*Continued*

AMERICAN OLD STYLE
AAAA
35 POUNDS COATING

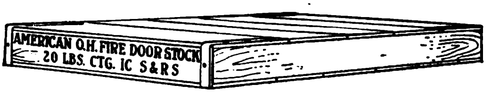
AMERICAN OLD STYLE "AAAA" TERNES—
35 lbs. coating. **Resquared and stamped**

AMERICAN OLD STYLE
AAAAA
40 POUNDS COATING

AMERICAN OLD STYLE "AAAAA" TERNES—
40 lbs. coating. **Resquared and stamped**

MF
32 POUNDS COATING

"MF" Terne. Special coating and finish. Made b the original old style palm oil process in use for over fift years. 32 lbs. coating, resquared and stamped.


AMERICAN O.H. FIRE DOOR STOCK
20 LBS. CTG. IC S&RS

AMERICAN OPEN HEARTH
IC
FIRE DOOR STOCK
20 POUNDS COATING

AMERICAN OPEN HEARTH FIRE DOOR STOC

Prepared specially to meet the requirements of th National Board of Fire Underwriters. 20 lbs. coatin resquared and stamped.

The cuts in the margin, opposite each grade, indicate the respective brand which are stamped on every sheet.

"American Special" and cheaper grades are resquared only when so ordered, and an extra charge is made therefor.

LONG TERNE SHEETS (Unassorted)

These sheets, sometimes called "Kalamein Iron", are supplied in the following grades from steel specially selected to meet individual requirements, and coated with a mixture of tin and lead.

AMERICAN TERNE GRADE, 8 lbs. coating.
AMERICAN EXTRA TERNE GRADE, 12 lbs. coating.
AMERICAN SPECIAL TERNE GRADE, 15 lbs. coating.
AMERICAN OLD STYLE "A" GRADE, 20 lbs. coating.

SIZE LIMITS.—Width up to 40″ (1.016m); length up to 120″ (3.048m), inclusive. The coating specified is per box of 112 sheets 20″ x 28″ (508 x 712 m/m). Packed regularly for shipment in bundles of about 150 lbs. (68 kilos) or, when so ordered, in skeleton crates or tight wooden boxes containing approximately 500 lbs. (227 kilos) for which an extra charge is made.

TUBES, PIPE AND TUBULAR GOODS

To readily identify "NATIONAL" material, and as protection to manufacturer and consumer alike, the practice of National Tube Company is to roll in raised letters of good size on each few feet of every length of welded pipe the name "NATIONAL" (except on the smaller butt-welded sizes, on which this is not mechanically feasible). When writing specifications or ordering tubular goods, specify "NATIONAL" Pipe.

All sizes of "NATIONAL" welded pipe below four or five inches are subjected to a roll-knobbling process known as Spellerizing to lessen the tendency to corrosion, especially in the form of pitting. This Spellerizing process is peculiar to "NATIONAL" Pipe, to which process National Tube Company has exclusive rights.

Tube and Pipe Trade Customs

Every piece of pipe, tubing, casing, boiler tube, line pipe, etc., is carefully tested, but as it is impossible to always detect imperfections, the only guarantee that is given is to replace such goods as prove defective. Under no circumstances are we responsible for any damages beyond the price of the goods. No charges for labor or expense required to repair defective goods or occasioned by them will be allowed. If the goods are defective the measure of damages is the price of the defective pieces.

Claims for shortage or deductions for erroneous charges must be promptly presented or will not be allowed.

The outside diameter of goods heavier than "standard" is the same as standard, the extra thickness being on the inside, so that the different weights of the same size use the same coupling.

Special goods made to specification, where buyer is to inspect, must be inspected and accepted before shipment is made. After shipment is made our responsibility ceases.

Requests for cancellation of orders, calling for odd sizes or cut lengths, will not be considered, if the manufacture of the material has been commenced when the request reaches the mill.

PROTECTIVE COATINGS

For the protection of pipe we galvanize or dip hot in bituminous compound, which may afterwards be covered with strong fabric saturated with protective compound, or paint as specified.

GALVANIZING

Where galvanizing is required, the finished pipe is cleaned free from scale by pickling in warm dilute sulphuric acid; the pipe is then washed in a bath of water; then immersed in an alkaline or neutral bath, then dried and immersed in molten zinc, being allowed to remain in the bath until it acquires the temperature of the zinc. No wiping or scraping device is used which will render the zinc coating thin. When cool, the clean galvanized pipe may be coated when specifically required.

BITUMINOUS COATING

In preparation for coating with the National Tube Company's pipe dip, each pipe is thoroughly cleansed inside and outside from all loose scale, dirt, rust, etc., and then heated until perfectly dry. The pipes are then transferred to the dip bath before they become chilled, and remain in the dip sufficient time for the pipe and bath to reach practically the same temperature. The immersion in the dip is horizontal and the pipes are lifted out at sufficient angle to allow the surplus coating to drain off before it has time to harden. The bath is maintained at a practically constant temperature which is not less than the boiling point of water. The compound consists of a good quality of mineral rubber free from water and the lighter oils, and of such uniform consistency that it will not be liable to chip off in ordinary cold weather nor to soften unduly so as to run when exposed to a reasonable amount of solar heat. After dipping, the pipe is dusted, while still warm, with a light color Portland cement.

If any other compound is required, it must be clearly specified, otherwise the National Tube Company standard pipe dip will be applied.

PAINT

Paint will be applied according to specifications from customers.

"NATIONAL" COATING

The attention of the public (especially of water and gas companies and engineers) is directed to "National" Coating. This is the latest and best protection of steel pipe against external corrosion, and electrolysis. It can now be applied to pipe ranging in size from ¾ to 30 inches outside diameter.

PROTECTIVE COATINGS FOR PIPE.—*Continued*

Process of Applying "National" Coating.—The pipe is first cleansed and dried, and while still at a temperature above the boiling point of water, it is dipped into a hot bath of mineral rubber compound and kept there until the pipe has the same temperature as the bath. On removal from the bath the pipe is allowed to drain vertically and cool, leaving the pipe covered inside and outside with an elastic compound, the consistency of which can readily be adapted to the temperature conditions under which the pipe is to be used. By a second operation this enamel-like surface is wrapped with a strip of fabric which has been thoroughly saturated with the hot compound. Immediately after being saturated with the compound the fabric is wound spirally over the surface of the pipe, over-lapping about one inch on each turn, covering and firmly adhering to the body coat. Two or three thicknesses may be applied in this way where desired to meet special conditions. A light color Portland cement is applied to the outer surface, so as to firmly adhere to the compound. The average thickness of ordinary paints or bituminous dips rarely exceeds 1-100 inch, but in the case of one-ply "National" Coating the thickness of protection amounts to about 3-64 inch.

Summarizing the Advantages of "National" Coating.—Exclusion of moisture. This is the main purpose kept in view in applying "National" Coating to pipe. So long as moisture is prevented from reaching the metal, no corrosion nor electrolysis is possible.

A much heavier coating may be safely applied to the surface when reinforced by fabric as described.

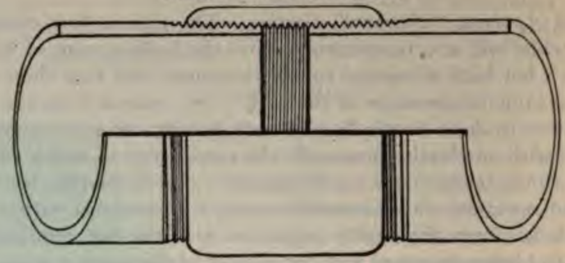
The saturated fabric affords considerable protection against damage to the coating through impact or abrasion and protects the foundation coat, which might otherwise be seriously injured thereby.

When the wrapping has been injured by abuse in handling, it can be readily and inexpensively repaired in the field by the application of strips of fabric saturated with the compound.

Compared with cast iron, soft steel pipe may be made more durable by this system of protection so that advantage may be taken of the far greater strength, ductility and lighter weight of soft steel without sacrificing durability.

"NATIONAL" AMERICAN STANDARD WEIGHT STEAM, GAS AND WATER TUBES

BLACK AND GALVANIZED



Nominal Inside Diameter		Weight		Thickness		Outside Diameter		Number of Threads per Inch of Screw
Inches	m/m	Per Foot, Lbs.	Per Mtr., Kilos	Inch	m/m	Inches	m/m	
⅛	3.17	.245	.365	.068	1.73	0.405	10.29	27
¼	6.35	.425	.632	.088	2.23	0.54	13.72	18
⅜	9.52	.568	.845	.091	2.31	0.675	17.15	18
½	12.70	.852	1.268	.109	2.77	0.84	21.34	14
¾	19.05	1.13	1.682	.113	2.87	1.05	26.67	14
1	25.40	1.68	2.500	.133	3.38	1.315	33.40	11½
1¼	31.75	2.28	3.393	.140	3.56	1.66	42.16	11½
1½	38.10	2.73	4.063	.145	3.68	1.9	48.26	11½
2	50.80	3.68	5.476	.154	3.91	2.375	60.32	11½
2½	63.50	5.82	8.661	.203	5.16	2.875	73.03	8
3	76.20	7.62	11.34	.216	5.49	3.5	88.90	8
3½	88.90	9.20	13.69	.226	5.74	4.	101.60	8
4	101.60	10.89	16.21	.237	6.02	4.5	114.30	8
4½	114.30	12.64	18.81	.247	6.27	5.	127.00	8
5	127.00	14.81	22.04	.258	6.55	5.563	141.30	8
6	152.40	19.19	28.56	.280	7.11	6.625	168.28	8
7	177.80	23.77	35.37	.301	7.65	7.625	193.68	8
8	203.20	25.00	37.20	.277	7.04	8.625	219.08	8
8	203.20	28.81	42.87	.322	8.18	8.625	219.08	8
9	228.60	34.19	50.88	.342	8.69	9.625	244.48	8
10	254.00	32.00	47.62	.279	7.09	10.750	273.05	8
10	254.00	35.00	52.09	.307	7.80	10.750	273.05	8
10	254.00	41.13	61.21	.365	9.27	10.750	273.05	8
11	279.40	46.25	68.83	.375	9.52	11.750	298.45	8
12	304.80	45.00	66.97	.330	8.38	12.750	323.85	8
12	304.80	50.71	75.47	.375	9.52	12.750	323.85	8
13	330.20	55.82	83.07	.375	9.52	14.000	355.60	8
14	355.60	60.37	89.84	.375	9.52	15.000	381.00	8
15	381.00	64.50	95.99	.375	9.52	16.000	406.40	8

The permissible variation in weight is 5 per cent. above and 5 per cent. below.

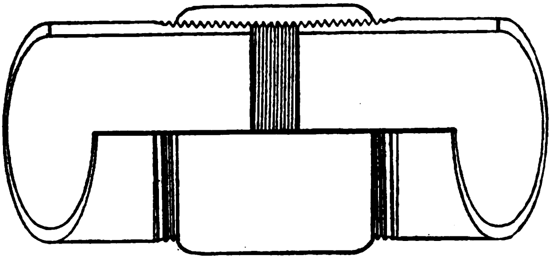
Furnished with threads and couplings and in random lengths unless otherwise ordered.

For cut lengths, an extra charge will be made above random lengths.

For pipe smoothed on the inside, known as reamed and drifted, an extra charge will be made above standard pipe.

For Galvanized or Coated pipe, an extra charge will be made above Black.

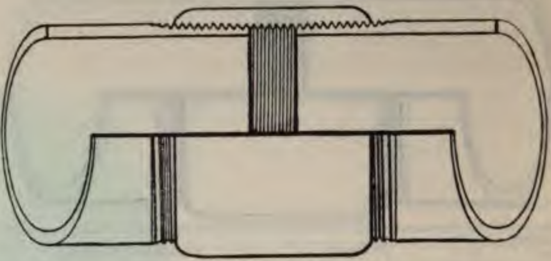
IONAL" BLACK AND GALVANIZED GAS TUBES, WITH ENGLISH THREAD



inal Inside iameter		Weight		Outside Diameter		Number of Threads per Inch of Screw
es	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	
	3.17	0.240	0.357	0.406	10.31	28
	6.35	0.421	0.627	0.531	13.49	19
	9.52	0.568	0.845	0.687	17.45	19
	12.70	0.865	1.287	0.844	21.44	14
	19.05	1.156	1.720	1.062	26.97	14
	25.40	1.726	2.569	1.344	34.14	11
	31.75	2.325	3.460	1.687	42.85	11
	38.10	2.768	4.119	1.906	48.41	11
	44.45	3.38	5.030	2.156	54.76	11
	50.80	3.704	5.512	2.375	60.32	11
	57.15	4.80	7.143	2.625	66.68	11
	63.50	5.26	7.828	3.	76.20	11
	69.85	5.73	8.527	3.25	82.55	11
	76.20	6.22	9.256	3.5	88.90	11
	88.90	7.34	10.923	4.	101.60	11
	101.60	8.33	12.396	4.5	114.30	11
	114.30	9.77	14.539	5.	127.00	11
	127.00	10.50	15.626	5.5	139.70	11
	152.40	12.50	18.602	6.5	165.10	11
	177.80	16.36	24.347	7.5	190.50	*11 or 10
	203.20	20.31	30.225	8.5	215.90	*11 or 10
	228.60	24.50	36.460	9.5	241.30	*11 or 10
	254.00	28.70	42.711	10.5	266.70	*11 or 10
	279.40	33.32	49.586	11.5	292.10	*11 or 8
	304.80	36.00	53.574	12.5	317.50	*11 or 8

ll furnish with 11 threads per inch of screw unless otherwise specified.
permissible variation in weight is 5 per cent. above and 5 per cent. below.
ished with threads and couplings and in random lengths unless otherwise ordered.
cut lengths, an extra charge will be made above random lengths.
pipe smoothed on the inside, known as reamed and drifted, an extra charge will be
above standard pipe.
Galvanized, or Coated pipe, an extra charge will be made above Black.

"NATIONAL" STEAM TUBES—PAINTED RED. ENGLISH STANDARD WEIGHTS. ENGLISH THREADS



Nominal Inside Diameter		Weight		Outside Diameter		Number of Threads per Inch of Screw
Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	
⅛	3.17	0.33	0.491	0.406	10.31	28
¼	6.35	0.44	0.655	0.531	13.49	19
⅜	9.52	0.67	0.997	0.687	17.45	19
½	12.70	0.94	1.399	0.844	21.44	14
¾	19.05	1.48	2.202	1.062	26.97	14
1	25.40	2.03	3.021	1.344	34.14	11
1¼	31.75	2.92	4.345	1.687	42.85	11
1½	38.10	3.56	5.298	1.906	48.41	11
1¾	44.45	4.26	6.340	2.156	54.76	11
2	50.80	4.83	7.188	2.375	60.32	11
2¼	57.15	5.74	8.542	2.625	66.68	11
2½	63.50	6.29	9.360	3.	76.20	11
2¾	69.85	6.85	10.194	3.25	82.55	11
3	76.20	7.40	11.012	3.50	88.90	11
3½	88.90	8.50	12.650	4.	101.60	11
4	101.60	9.60	14.287	4.50	114.30	11
4½	114.30	12.80	19.049	5.	127.00	11
5	127.00	14.20	21.132	5.50	139.70	11
6	152.40	17.04	25.359	6.50	165.10	11

The permissible variation in weight is 5 per cent. above and 5 per cent. belo

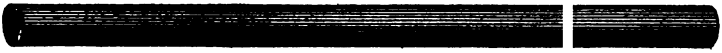
Furnished with threads and couplings and in random lengths unless othe wise ordered.

For cut lengths, an extra charge will be made above random lengths.

For pipe smoothed on the inside, known as reamed and drifted, an ext charge will be made above standard pipe.

For Galvanized, or Coated pipe, an extra charge will be made above Blac

"NATIONAL" AMERICAN STANDARD, EXTRA STRONG STEAM, GAS AND WATER TUBES



ize, ches	Outside Diameter		Inside Diameter		Thickness		Weight	
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
⅛	.405	10.29	.215	5.46	.095	2.41	.314	.467
¼	.540	13.72	.302	7.67	.119	3.02	.535	.796
⅜	.675	17.15	.423	10.74	.126	3.20	.738	1.098
½	.840	21.34	.546	13.87	.147	3.73	1.087	1.618
¾	1.05	26.67	.742	18.85	.154	3.91	1.473	2.192
1	1.315	33.40	.957	24.31	.179	4.55	2.171	3.231
1¼	1.66	42.16	1.278	32.46	.191	4.85	2.996	4.459
1½	1.90	48.26	1.500	38.10	.200	5.08	3.631	5.404
2	2.375	60.32	1.939	49.25	.218	5.54	5.022	7.474
2½	2.875	73.03	2.323	59.00	.276	7.01	7.661	11.40
3	3.500	88.90	2.900	73.66	.300	7.62	10.252	15.26
3½	4.000	101.60	3.364	85.45	.318	8.08	12.505	18.61
4	4.500	114.30	3.826	97.18	.337	8.56	14.983	22.30
4½	5.000	127.00	4.290	108.97	.355	9.02	17.611	26.21
5	5.563	141.30	4.813	122.25	.375	9.52	20.778	30.92
6	6.625	168.28	5.761	146.33	.432	10.97	28.573	42.52
7	7.625	193.68	6.625	168.28	.500	12.70	38.048	56.62
8	8.625	219.08	7.625	193.68	.500	12.70	43.388	64.57
9	9.625	244.48	8.625	219.08	.500	12.70	48.728	72.52
10	10.750	273.05	9.750	247.65	.500	12.70	54.735	81.46
11	11.750	298.45	10.750	273.05	.500	12.70	60.075	89.40
12	12.750	323.85	11.750	298.45	.500	12.70	65.415	97.35

The permissible variation in weight is 5 per cent. above and 5 per cent. below.

Furnished with plain ends and in random lengths unless otherwise ordered.

Random length of extra strong pipe is considered to be 12 feet to 22 feet, we to have the privilege, however, of supplying not exceeding 5 per cent. of total order in lengths from 6 feet to 12 feet.

For pipe fitted with threads and couplings, an extra charge will be made above plain ends.

For cut lengths, an extra charge will be made above random lengths.

For Galvanized, or Coated pipe, an extra charge will be made above Black.

"NATIONAL" AMERICAN STANDARD, DOUBI EXTRA STRONG STEAM, GAS AND WATER TUBES

Size, Inches	Outside Diameter		Inside Diameter		Thickness		Weigh
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds
½	.84	21.34	.252	6.40	.294	7.47	1.714
¾	1.05	26.67	.434	11.02	.308	7.82	2.440
1	1.315	33.40	.599	15.21	.358	9.09	3.659
1¼	1.66	42.16	.896	22.76	.382	9.70	5.214
1½	1.90	48.26	1.100	27.94	.400	10.16	6.408
2	2.375	60.32	1.503	38.18	.436	11.07	9.029
2½	2.875	73.03	1.771	44.98	.552	14.02	13.695
3	3.50	88.90	2.300	58.42	.600	15.24	18.583
3½	4.00	101.60	2.728	69.29	.636	16.15	22.850
4	4.50	114.30	3.152	80.06	.674	17.12	27.541
4½	5.00	127.00	3.580	90.93	.710	18.03	32.530
5	5.563	141.30	4.063	103.20	.750	19.05	38.552
6	6.625	168.28	4.897	124.38	.864	21.95	53.160
7	7.625	193.68	5.875	149.23	.875	22.23	63.079
8	8.625	219.08	6.875	174.63	.875	22.23	72.424

The permissible variation in weight is 10 per cent. above and 10 p below.

Furnished with plain ends and in random lengths, unless otherwise

Random length of double extra strong pipe is considered to be 12 22 feet, we to have the privilege, however, of supplying not exceedir cent. of total order in lengths from 6 feet to 12 feet.

For pipe fitted with threads and couplings, an extra charge will t above plain ends.

For cut lengths, an extra charge will be made above random length

For Galvanized or Coated pipe, an extra charge will be made above E

For Extra Heavy or Hydraulic tubes, varying from standard, speci will be quoted on receipt of complete specifications.

"NATIONAL" LARGE O. D. TUBES

PLAIN ENDS

Size, Outside Diameter		Thickness, Inches	Equivalents in Millimeters of Thickness
nches	m/m		
14	355.60	$\frac{1}{4}, \frac{5}{16}, \frac{3}{8}, \frac{7}{16}, \frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{11}{16}, \frac{3}{4}, \frac{7}{8}, 1, 1\frac{1}{8}$	$\frac{1}{4}$" equivalent to 6.35 m/m
15	381.00	$\frac{1}{4}, \frac{5}{16}, \frac{3}{8}, \frac{7}{16}, \frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{11}{16}, \frac{3}{4}, \frac{7}{8}, 1, 1\frac{1}{8}$	$\frac{5}{16}$" " " 7.94 "
16	406.40	$\frac{1}{4}, \frac{5}{16}, \frac{3}{8}, \frac{7}{16}, \frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{11}{16}, \frac{3}{4}, \frac{7}{8}, 1, 1\frac{1}{8}$	$\frac{3}{8}$" " " 9.53 "
17	431.80	$\frac{1}{4}, \frac{5}{16}, \frac{3}{8}, \frac{7}{16}, \frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{11}{16}, \frac{3}{4}, \frac{7}{8}, 1, 1\frac{1}{8}$	$\frac{7}{16}$" " " 11.11 "
18	457.20	$\frac{1}{4}, \frac{5}{16}, \frac{3}{8}, \frac{7}{16}, \frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{11}{16}, \frac{3}{4}, \frac{7}{8}, 1, 1\frac{1}{8}$	$\frac{1}{2}$" " " 12.70 "
20	508.00	$\frac{5}{16}, \frac{3}{8}, \frac{7}{16}, \frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{11}{16}, \frac{3}{4}, \frac{7}{8}, 1, 1\frac{1}{8}$	$\frac{9}{16}$" " " 14.29 "
21	533.40	$\frac{5}{16}, \frac{3}{8}, \frac{7}{16}, \frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{11}{16}, \frac{3}{4}$	$\frac{5}{8}$" " " 15.88 "
22	558.80	$\frac{5}{16}, \frac{3}{8}, \frac{7}{16}, \frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{11}{16}, \frac{3}{4}$	$\frac{11}{16}$" " " 17.46 "
24	609.60	$\frac{3}{8}, \frac{7}{16}, \frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{11}{16}, \frac{3}{4}$	$\frac{3}{4}$" " " 19.05 "
26	660.40	$\frac{3}{8}, \frac{7}{16}, \frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{11}{16}, \frac{3}{4}$	$\frac{7}{8}$" " " 22.23 "
28	711.20	$\frac{7}{16}, \frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{11}{16}, \frac{3}{4}$	1" " " 25.40 "
30	762.00	$\frac{7}{16}, \frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{11}{16}, \frac{3}{4}$	$1\frac{1}{8}$" " " 28.58 "

The permissible variation in weight for sizes 14", 15" and 16", thicknesses $\frac{3}{8}$" and less, is 5 per cent. above and 5 per cent. below. For all other sizes and thicknesses the permissible variation is 10 per cent. above and 10 per cent. below.

Inquiries and orders should state outside diameter and thickness required.

These tubes will be shipped in random lengths, plain ends, unless otherwise ordered.

For cut lengths, an extra charge will be made above random lengths.

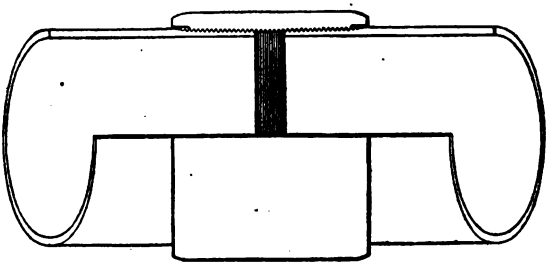
For threaded tubes an extra charge above plain ends will be made.

We can thread up to 24 inches (609.6 m/m).

We can thread and couple up to 20 inches (508 m/m).

For tubes threaded, larger than 24" O. D., or tubes threaded and coupled larger than 20" O. D., prices on application.

"NATIONAL" STANDARD BOSTON CASING



All weights and dimensions are nominal

Nominal Inside Diameter		Outside Diameter		Thickness		Weight		Nu T per
Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos	
2	50.80	2¼	57.15	.100	2.54	2.34	3.48	
2¼	57.15	2½	63.50	.108	2.74	2.82	4.20	
2½	63.50	2¾	69.85	.113	2.87	3.25	4.84	
2¾	69.85	3	76.20	.116	2.95	3.65	5.43	
3	76.20	3¼	82.55	.120	3.05	4.10	6.10	
3¼	82.55	3½	88.90	.125	3.17	4.60	6.85	
3½	88.90	3¾	95.25	.129	3.28	5.10	7.59	
3¾	95.25	4	101.60	.134	3.40	5.65	8.41	
4	101.60	4¼	107.95	.138	3.50	6.20	9.23	
4¼	107.95	4½	114.30	.142	3.61	6.75	10.05	
4½	114.30	4¾	120.65	.145	3.68	7.25	10.79	
4¾	120.65	5	127.00	.152	3.86	8.00	11.91	
5	127.00	5¼	133.35	.153	3.89	8.50	12.65	
5 3/16	131.76	5½	139.70	.154	3.91	9.00	13.39	
5⅝	142.88	6	152.40	.164	4.17	10.50	15.63	
6¼	158.75	6⅝	168.28	.169	4.29	12.00	17.86	
6⅝	168.28	7	177.80	.174	4.42	13.00	19.35	
7¼	184.15	7⅝	193.68	.181	4.60	14.75	21.95	
7⅝	193.68	8	203.20	.186	4.72	16.00	23.81	
8¼	209.55	8⅝	219.08	.188	4.77	17.50	26.04	
8⅝	219.08	9	228.60	.196	4.98	19.00	28.28	
9⅝	244.48	10	254.00	.209	5.31	22.75	33.86	
10⅝	269.88	11	279.40	.224	5.69	26.75	39.81	
11⅝	295.28	12	304.80	.243	6.17	31.50	46.88	
12½	317.50	13	330.20	.259	6.58	36.50	54.32	
13½	342.90	14	355.60	.276	7.01	42.00	62.50	
14½	368.30	15	381.00	.291	7.39	47.50	70.69	
15½	393.70	16	406.40	.302	7.67	52.50	78.13	

The permissible variation in weight is 5 per cent. above and 5 per cent. below.
Furnished with threads and couplings and in random lengths, unless otherwise orde
Thickness of walls makes it impracticable to cut threads of coarser pitch than sl
table.
For cut lengths, an extra charge will be made above random.
For Galvanized, or Coated casing, an extra charge will be made above Black.

"NATIONAL" OIL WELL BOSTON CASING

(For illustration, see page 206)

All weights and dimensions are nominal

Nominal Inside Diameter		Outside Diameter		Thickness		Nominal Weight		Number of Threads per Inch of Screw
Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos	
4¼	107.95	4½	114.30	.142	3.61	6.75	10.05	14
4¼	107.95	4½	114.30	.205	5.21	9.50	14.14	14
4½	114.30	4¾	120.65	.145	3.68	7.25	10.79	14
4½	114.30	4¾	120.65	.193	4.90	9.50	14.14	14
4¾	120.65	5	127.00	.152	3.86	8.00	11.91	14
5	127.00	5¼	133.35	.153	3.89	8.50	12.65	14
5	127.00	5¼	133.35	.182	4.62	10.00	14.88	14
5	127.00	5¼	133.35	.182	4.62	10.00	14.88	11½
5	127.00	5¼	133.35	.241	6.12	13.00	19.35	11½
5	127.00	5¼	133.35	.301	7.65	16.00	23.81	11½
5 3/16	131.76	5½	139.70	.154	3.91	9.00	13.39	14
*5 3/16	131.76	5½	139.70	.228	5.79	13.00	19.35	11½
*5 3/16	131.76	5½	139.70	.304	7.72	17.00	25.30	11½
5⅝	142.88	6	152.40	.164	4.17	10.50	15.63	14
5⅝	142.88	6	152.40	.190	4.83	12.00	17.86	11½
5⅝	142.88	6	152.40	.224	5.69	14.00	20.83	11½
5⅝	142.88	6	152.40	.275	6.98	17.00	25.30	11½
6¼	158.75	6⅝	168.28	.169	4.29	12.00	17.86	14
6¼	158.75	6⅝	168.28	.185	4.70	13.00	19.35	14
*6¼	158.75	6⅝	168.28	.184	4.67	13.00	19.35	11½
*6¼	158.75	6⅝	168.28	.245	6.22	17.00	25.30	11½
*6¼	158.75	7	168.28	.292	7.42	20.00	29.76	11½
*6¼	158.75	6⅝	168.28	.356	9.04	24.00	35.72	11½
6⅝	168.28	7	177.80	.174	4.42	13.00	19.35	14
6⅝	168.28	7	177.80	.231	5.87	17.00	25.30	11½
*6⅝	168.28	7	177.80	.231	5.87	17.00	25.30	10
*6⅝	168.28	7	177.80	.275	6.98	20.00	29.76	10
*6⅝	168.28	7	177.80	.333	8.46	24.00	35.72	10
7¼	184.15	7⅝	193.68	.181	4.60	14.75	21.95	14
7⅝	193.68	8	203.20	.186	4.72	16.00	23.81	11½
7⅝	193.68	8	203.20	.236	5.99	20.00	29.76	11½
8¼	209.55	8⅝	219.08	.188	4.77	17.50	26.04	11½
8¼	209.55	8⅝	219.08	.217	5.51	20.00	29.76	11½
8¼	209.55	8⅝	219.08	.264	6.71	24.00	35.72	11½
*8¼	209.55	8⅝	219.08	.264	6.71	24.00	35.72	8
*8¼	209.55	8⅝	219.08	.311	7.90	28.00	41.67	8
*8¼	209.55	8⅝	219.08	.359	9.12	32.00	47.62	8
8⅝	219.08	9	228.60	.196	4.98	19.00	28.28	11½
9⅝	244.48	10	254.00	.209	5.31	22.75	33.86	11½
†9⅝	244.48	10	254.00	.283	7.19	30.25	45.02	11½
*10	254.00	10¾	273.05	.279	7.09	32.52	48.39	8
*10	254.00	10¾	273.05	.302	7.67	35.00	52.09	8
*10	254.00	10¾	273.05	.350	8.89	40.00	59.53	8
10⅝	269.88	11	279.40	.224	5.69	26.75	39.81	11½
11⅝	295.28	12	304.80	.243	6.17	31.50	46.88	11½
12½	317.50	13	330.20	.259	6.58	36.50	54.32	11½
*12½	317.50	13	330.20	.322	7.92	45.00	66.97	8
*12½	317.50	13	330.20	.361	9.17	50.00	74.41	8
13½	342.90	14	355.60	.276	7.01	42.00	67.50	11½
14½	368.30	15	381.00	.291	7.39	47.50	70.69	11½
15½	393.70	16	406.40	.302	7.67	52.50	78.13	11½

*These items are fitted with South Penn Couplings.

†This item is fitted with Pacific Couplings.

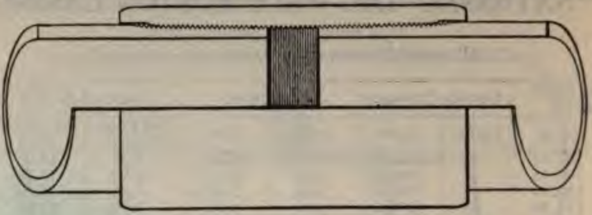
The permissible variation in weight is 5 per cent. above and 5 per cent. below.

Furnished with threads and couplings and in random lengths, unless otherwise ordered.

For cut lengths, an extra charge will be made above random lengths.

For Galvanized, or Coated casing, an extra charge will be made above Black.

"NATIONAL" CALIFORNIA DIAMOND BX CASING



All weights and dimensions are nominal

Size		External Diameter		Thickness		Weight		No. of Threads per Inch of Screw	Couplings			
									Diameter		Length	
Ins.	m/m	Ins.	m/m	In.	m/m	Per Foot, Lbs.	Per Mtr., Kilos		Ins.	m/m	Ins.	m/m
4½	114.30	4¾	120.65	.334	8.48	16.00	23.81	10	5.36	136.1	6⅝	168.28
4¾	120.65	5	127.00	.250	6.35	12.85	19.12	10	5.49	139.4	6⅝	168.28
4¾	120.65	5	127.00	.296	7.52	15.0	22.32	10	5.49	139.4	6⅝	168.28
5⅝	142.88	6	152.40	.324	8.23	20.0	29.76	10	6.77	172.0	7⅛	180.98
6¼	158.75	6⅝	168.28	.288	7.32	20.0	29.76	10	7.39	187.7	7⅝	193.67
6¼	158.75	6⅝	168.28	.352	8.94	24.0	35.72	10	7.39	187.7	7⅝	193.67
6¼	158.75	6⅝	168.28	.385	9.78	26.0	38.69	10	7.39	187.7	7⅝	193.67
6¼	158.75	6⅝	168.28	.417	10.59	28.0	41.67	10	7.39	187.7	7⅝	193.67
6⅝	168.28	7	177.80	.272	6.91	20.0	29.76	10	7.70	195.6	7⅝	193.67
6⅝	168.28	7	177.80	.332	8.43	24.0	35.72	10	7.70	195.6	7⅝	193.67
6⅝	168.28	7	177.80	.362	9.19	26.0	38.69	10	7.70	195.6	7⅝	193.67
6⅝	168.28	7	177.80	.393	9.98	28.0	41.67	10	7.70	195.6	7⅝	193.67
6⅝	168.28	7	177.80	.423	10.74	30.0	44.65	10	7.70	195.6	7⅝	193.67
7⅝	193.68	8	203.20	.307	7.80	26.0	38.69	10	8.89	225.8	8⅛	206.38
*8¼	209.55	8⅝	219.08	.304	7.72	28.0	41.67	10	9.63	244.6	8⅛	206.38
*8¼	209.55	8⅝	219.08	.352	8.94	32.0	47.62	10	9.63	244.6	8⅛	206.38
*8¼	209.55	8⅝	219.08	.400	10.16	36.0	53.57	10	9.63	244.6	8⅛	206.38
*8¼	209.55	8⅝	219.08	.425	10.80	38.0	56.55	10	9.63	244.6	8⅛	206.38
*8¼	209.55	8⅝	219.08	.487	12.37	43.0	63.99	10	9.63	244.6	8⅛	206.38
9⅝	244.48	10	254.00	.308	7.82	33.0	49.11	10	11.00	279.4	8⅛	206.38
*10	254.00	10¾	273.05	.348	8.84	40.0	59.53	10	11.87	301.5	8⅛	206.38
*10	254.00	10¾	273.05	.395	10.03	45.0	66.97	10	11.87	301.5	8⅛	206.38
*10	254.00	10¾	273.05	.424	10.77	48.0	71.43	10	11.87	301.5	8⅛	206.38
*10	254.00	10¾	273.05	.483	12.27	54.0	80.36	10	11.87	301.5	8⅛	206.38
11	279.40	11¾	298.40	.375	9.53	47.0	69.94	10	12.87	326.9	8⅛	206.38
11	279.40	11¾	298.40	.489	12.42	60.0	89.29	10	12.87	326.9	8⅛	206.38
11⅝	295.28	12	304.80	.308	7.82	40.0	59.53	10	13.12	333.2	8⅛	206.38
*12½	317.50	13	330.20	.281	7.14	40.0	59.53	10	14.12	358.6	8⅛	206.38
*12½	317.50	13	330.20	.320	8.13	45.0	66.97	10	14.12	358.6	8⅛	206.38
*12½	317.50	13	330.20	.359	9.12	50.0	74.41	10	14.12	358.6	8⅛	206.38
*12½	317.50	13	330.20	.390	9.91	54.0	80.36	10	14.12	358.6	8⅛	206.38
13½	342.90	14	355.60	.328	8.33	50.0	74.41	10	15.15	384.8	9⅛	231.78
*15½	393.70	16	406.40	.401	10.19	70.0	104.17	10	17.48	444.0	9⅛	231.78

The permissible variation in weight is 5 per cent. above and 5 per cent. below.

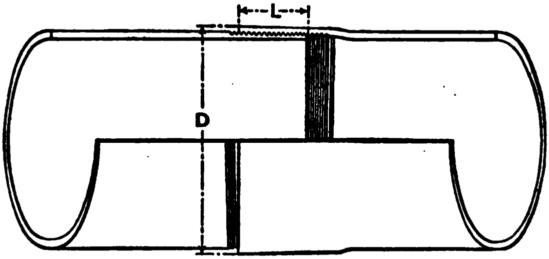
Furnished with threads and couplings and in random lengths, unless otherwise ordered.

This casing not furnished in lighter weights, but can be made heavier than shown above.

When one size of casing is intended to telescope with another, it should always be specified when ordering.

*When so ordered, these sizes and weights will be fitted with couplings of approximately the dimensions as shown above and both the casing and couplings threaded 8 threads per inch, ¾″ taper per foot.

"NATIONAL" INSERTED JOINT CASING

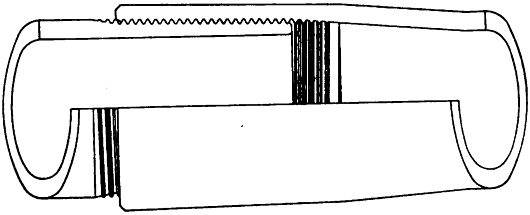


All weights and dimensions are nominal

External Diameter		Internal Diameter		Thickness		Weight		No. of Threads per Inch of Screw	Joint			
									Length L		Diameter D	
Ins.	m/m	Ins.	m/m	In.	m/m	Per Foot, Lbs.	Per Meter, Kilos		Ins.	m/m	Ins.	m/m
2¼	57.15	2.05	52.1	.100	2.54	2.30	3.42	14	.97	24.6	2.34	59.4
2½	63.50	2.28	57.9	.108	2.74	2.76	4.11	14	.99	25.1	2.61	66.3
2¾	69.85	2.52	64.0	.113	2.87	3.18	4.73	14	1.02	25.9	2.87	72.9
3	76.20	2.77	70.4	.116	2.95	3.57	5.31	14	1.04	26.4	3.12	79.2
3¼	82.55	3.01	76.5	.120	3.05	4.01	5.97	14	1.07	27.2	3.38	85.9
3½	88.90	3.25	82.5	.125	3.17	4.51	6.71	14	1.09	27.7	3.64	92.5
3¾	95.25	3.49	88.6	.129	3.28	4.99	7.43	14	1.12	28.4	3.90	99.1
4	101.60	3.73	94.7	.134	3.40	5.53	8.23	14	1.14	29.0	4.16	105.7
4¼	107.95	3.97	100.8	.138	3.50	6.06	9.02	14	1.17	29.7	4.42	112.3
4½	114.30	4.22	107.2	.142	3.61	6.61	9.84	14	1.19	30.2	4.67	118.6
4¾	120.65	4.46	113.3	.145	3.68	7.13	10.61	14	1.22	31.0	4.93	125.2
5	127.00	4.70	119.4	.152	3.86	7.87	11.71	14	1.24	31.5	5.19	131.8
5¼	133.35	4.94	125.5	.153	3.89	8.33	12.40	14	1.27	32.3	5.45	138.4
5½	139.70	5.19	131.8	.154	3.91	8.79	13.08	14	1.29	32.8	5.70	144.8
6	152.40	5.67	144.0	.164	4.17	10.22	15.21	14	1.34	34.0	6.22	158.0
6⅝	168.28	6.29	159.8	.169	4.29	11.65	17.34	14	1.41	35.8	6.85	174.0
7	177.80	6.65	168.9	.174	4.42	12.69	18.89	14	1.44	36.6	7.24	183.9
7⅝	193.68	7.26	184.4	.181	4.60	14.39	21.42	14	1.51	38.4	7.88	200.2
8	203.20	7.63	193.8	.186	4.72	15.52	23.10	11½	1.57	39.9	8.24	209.3
8⅝	219.08	8.25	209.5	.188	4.77	16.94	25.21	11½	1.64	41.7	8.87	225.3
9	228.60	8.61	218.7	.196	4.98	18.43	27.43	11½	1.67	42.4	9.26	235.2
10	254.00	9.58	243.3	.209	5.31	21.86	32.53	11½	1.77	45.0	10.28	261.1
11	279.40	10.55	268.0	.224	5.69	25.78	38.37	11½	1.87	47.5	11.31	287.3
12	304.80	11.51	292.4	.243	6.17	30.51	45.41	11½	1.97	50.0	12.35	313.7
13	330.20	12.48	317.0	.259	6.58	35.24	52.44	11½	2.07	52.6	13.38	339.9
14	355.60	13.45	341.6	.276	7.01	40.45	60.20	11½	2.17	55.1	14.42	366.3
15	381.00	14.42	366.3	.291	7.39	45.71	68.02	11½	2.27	57.7	15.45	392.4
16	406.40	15.40	391.2	.302	7.67	50.63	75.35	11½	2.37	60.2	16.47	418.3

e permissible variation in weight is 5 per cent. above and 5 per cent. below.
rnished in random lengths, unless otherwise ordered.
ickness of walls makes it impracticable to cut threads of coarser pitch shown in table.
r cut lengths, an extra charge will be made above random lengths.
r Galvanized or Coated pipe, an extra charge will be made above Black.

"NATIONAL" INSERTED JOINT CASING EXPORT STANDARD



All weights and dimensions are nominal

Size Inches	External Diameter		Thickness		Weight Plain Ends		Joint					Tes
							No. of Threads per Inch of Screw*	Length		Outside Diameter		Lb pe Sq Inc
	Ins.	m/m	In.	m/m	Per Foot Lbs.	Per Meter Kilos		Ins.	m/m	Ins.	m/m	
2	2¼	57.15	.240	6.10	5.152	7.67	10	2.200	55.88	2.608	66.24	220
2¼	2½	63.50	.240	6.10	5.792	8.62	10	2.200	55.88	2.858	72.59	220
2½	2¾	69.85	.240	6.10	6.433	9.57	10	2.200	55.88	3.108	78.94	200
2¾	3	76.20	.250	6.35	7.342	10.93	10	2.450	62.23	3.378	85.80	200
3	3¼	82.55	.250	6.35	8.010	11.92	10	2.450	62.23	3.628	92.15	200
3¼	3½	88.90	.250	6.35	8.677	12.91	10	2.450	62.23	3.878	98.50	200
3½	3¾	95.25	.260	6.60	9.691	14.42	10	2.700	68.58	4.148	105.36	200
3¾	4	101.60	.260	6.60	10.385	15.46	10	2.700	68.58	4.398	111.71	190
4	4¼	107.95	.260	6.60	11.079	16.49	10	2.950	74.93	4.648	118.06	180
4¼	4½	114.30	.260	6.60	11.773	17.52	10	2.950	74.93	4.898	124.41	170
4½	4¾	120.65	.260	6.60	12.468	18.55	10	3.200	81.28	5.148	130.76	160
4¾	5	127.00	.260	6.60	13.162	19.59	10	3.200	81.28	5.398	137.11	150
5	5¼	133.35	.260	6.60	13.856	20.62	10	3.700	93.98	5.648	143.46	140
5 3/16	5½	139.70	.270	6.86	15.081	22.44	10	3.700	93.98	5.918	150.32	130
5⅝	6	152.40	.270	6.86	16.523	24.59	10	3.950	100.33	6.418	160.02	130
6¼	6⅝	168.28	.270	6.86	18.325	27.27	10	3.950	100.33	7.043	178.90	120
6⅝	7	177.80	.270	6.86	19.406	28.88	10	4.200	106.70	7.418	188.42	120
7¼	7⅝	193.68	.270	6.86	21.209	31.56	10	4.200	106.70	8.043	204.30	110
7⅝	8	203.20	.280	7.11	23.086	34.46	10	4.450	113.03	8.438	214.32	110
8¼	8⅝	219.08	.280	7.11	24.955	37.14	10	4.450	113.03	9.063	230.20	100
8⅝	9	228.60	.290	7.37	26.977	40.15	10	4.700	119.38	9.458	240.23	100
9⅝	10	254.00	.290	7.37	30.074	44.76	8	4.625	117.48	10.428	264.87	90
10⅝	11	279.40	.310	7.87	35.392	52.67	8	4.875	123.83	11.468	291.21	80
11⅝	12	304.80	.310	7.87	38.703	57.60	8	4.875	123.83	12.468	316.69	80
12½	13	330.20	.350	8.89	47.286	70.37	8	5.125	130.18	13.548	344.12	80
13½	14	355.60	.350	8.89	51.024	75.93	8	5.125	130.18	14.548	369.52	75
14½	15	381.00	.380	9.65	59.334	88.30	8	5.625	142.88	15.608	396.44	75
15½	16	406.40	.380	9.65	63.393	94.34	8	5.625	142.88	16.608	421.84	75
17 OD	17	431.80	.380	9.65	67.451	100.38	8	5.625	142.88	17.608	447.24	70
18 OD	18	457.20	.437	11.10	81.970	121.99	8	5.625	142.88	18.722	475.54	70
19 OD	19	482.60	.437	11.10	86.637	128.93	8	5.625	142.88	19.722	500.94	65
20 OD	20	508.00	.437	11.10	91.305	135.88	8	5.625	142.88	20.722	526.34	60

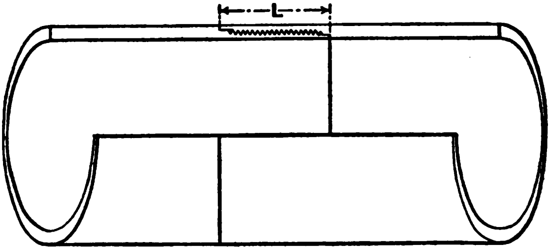
*Whitworth threads.

The permissible variation in weight is 5 per cent. above and 5 per cent.

Furnished in random lengths, unless otherwise ordered.

For cut lengths, an extra charge will be made above random length

"NATIONAL" FLUSH JOINT TUBING



All weights and dimensions are nominal

Size, Inches	External Diameter		Internal Diameter		Thickness		Weight		No. of Threads per Inch of Screw	Length of Joint L	
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos		Inches	m/m
3	3½	88.90	3.07	77.98	.216	5.49	7.58	11.28	14	1¾	44.45
3½	4	101.60	3.55	90.17	.226	5.74	9.11	13.56	14	1¾	44.45
4	4½	114.30	4.03	102.36	.237	6.02	10.79	16.06	11½	1¾	44.45
4½	5	127.00	4.51	114.55	.247	6.27	12.54	18.66	11½	1¾	44.45
5	5 9/16	141.29	5.05	128.27	.258	6.55	14.62	21.76	11½	2	50.80
	6	152.40	5.44	138.18	.280	7.11	17.11	25.46	11½	2	50.80
6	6⅝	168.28	6.07	154.18	.280	7.11	18.97	28.23	11½	2	50.80
	7	177.80	6.40	162.56	.301	7.65	21.54	32.05	11½	2	50.80
7	7⅝	193.68	7.02	178.31	.301	7.65	23.54	35.03	11½	2	50.80
	8	203.20	7.36	186.94	.322	8.18	26.40	39.29	10	2	50.80
8	8⅝	219.08	7.98	202.69	.322	8.18	28.55	42.49	10	2	50.80
	9	228.60	8.32	211.33	.342	8.69	31.62	47.06	10	2	50.80
9	9⅝	244.48	8.94	227.08	.342	8.69	33.91	50.46	10	2	50.80
	10	254.00	9.27	235.46	.365	9.27	37.56	55.90	10	2¼	57.15
10	10¾	273.05	10.02	254.51	.365	9.27	40.48	60.24	10	2¼	57.15
	12	304.80	11.25	285.75	.375	9.52	46.56	69.29	10	2¼	57.15
12	12¾	323.85	12.00	304.80	.375	9.52	49.56	73.75	10	2¼	57.15
13	14	355.60	13.12	333.25	.438	11.12	63.44	94.41	8	2½	63.50
14	15	381.00	14.12	358.65	.438	11.12	68.12	101.37	8	2½	63.50
15	16	406.40	15.00	381.00	.500	12.70	82.77	123.18	8	2½	63.50
18OD	18	457.20	17.00	431.80	.500	12.70	93.45	139.07	8	2½	63.50

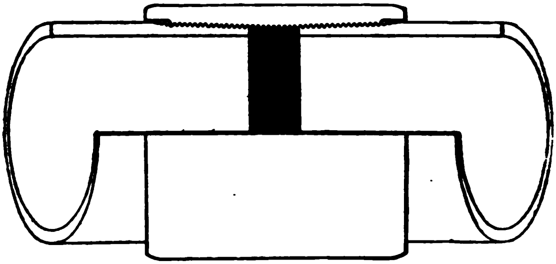
The permissible variation in weight is 5 per cent. above and 5 per cent. below.

Furnished in random lengths, unless otherwise ordered.

Weights lighter than those given in above table are not suitable for flush joints.

"NATIONAL" OIL WELL TUBING

Fitted with V Threads and Long Protecting Sleeve Socket



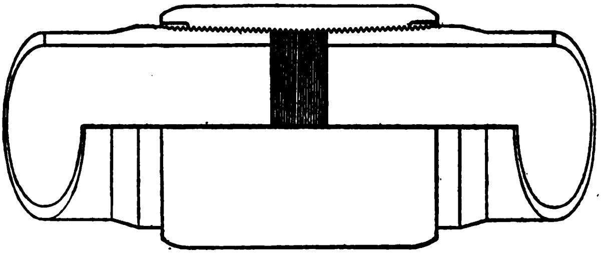
All weights and dimensions are nominal

Nominal Internal Diameter		External Diameter		Thickness		Weight		No. of Threads per Inch of Screw	Couplings			
									External Diameter		Length	
Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Lbs.	Per Meter, Kilos		Inches	m/m	Inches	m/m
1¼	31.75	1.660	42.16	.140	3.56	2.30	3.42	11½	2.05	52.07	2⅞	73.03
1½	38.10	1.900	48.26	.145	3.68	2.75	4.09	11½	2.29	58.17	2⅞	73.03
2	50.80	2.375	60.32	.167	4.24	4.00	5.95	11½	2.84	72.14	3⅝	92.08
2	50.80	2.375	60.32	.190	4.83	4.50	6.70	11½	2.84	72.14	3⅝	92.08
2½	63.50	2.875	73.03	.203	5.16	5.90	8.78	11½	3.45	87.63	4⅛	104.78
2½	63.50	2.875	73.03	.217	5.51	6.25	9.30	11½	3.45	87.63	4⅛	104.78
3	76.20	3.500	88.90	.216	5.49	7.69	11.44	11½	4.07	103.38	4⅛	104.78
3	76.20	3.500	88.90	.241	6.12	8.50	12.65	11½	4.07	103.38	4⅛	104.78
3	76.20	3.500	88.90	.289	7.34	10.00	14.88	11½	4.07	103.38	4⅛	104.78
3½	88.90	4.000	101.60	.226	5.74	9.26	13.78	8	4.63	117.60	4⅛	104.78
4	101.60	4.500	114.30	.237	6.02	10.98	16.34	8	5.23	132.84	4⅛	104.78
4	101.60	4.500	114.30	.255	6.48	11.75	17.49	8	5.23	132.84	4⅛	104.78

The permissible variation in weight is 5 per cent. above and 5 per cent. below.

Furnished with threads and couplings and in random lengths, unless otherwise ordered.

"NATIONAL" CALIFORNIA SPECIAL EXTERNAL UPSET TUBING



All weights and dimensions are nominal

Nominal Internal Diameter		External Diameter		Thickness		Weight		No. of Thr'ds per Inch of Screw	Couplings			
									External Diameter		Length	
ches	m/m	Inches	m/m	Inch	m/m	Per Foot, Lbs.	Per Meter, Kilos		Inches	m/m	Inches	m/m
1¼	31.75	1.660	42.16	.140	3.56	2.30	3.42	11½	2.20	55.88	2⅞	73.03
2	50.80	2.375	60.32	.167	4.24	4.00	5.95	11½	3.06	77.72	3⅝	92.08
2	50.80	2.375	60.32	.190	4.83	4.50	6.70	11½	3.06	77.72	3⅝	92.08
2½	63.50	2.875	73.03	.217	5.51	6.25	9.30	11½	3.67	93.22	4⅛	104.78
3	76.20	3.500	88.90	.241	6.12	8.63	12.84	10	4.50	114.30	5⅛	130.18
4	101.60	4.500	114.30	.271	6.88	12.50	18.60	10	5.35	135.89	6⅛	155.58

The permissible variation in weight is 5 per cent. above and 5 per cent. below.
Furnished with threads and couplings and in random lengths, unless otherwise ordered.

"NATIONAL" CALIFORNIA DIAMOND BX TUBING

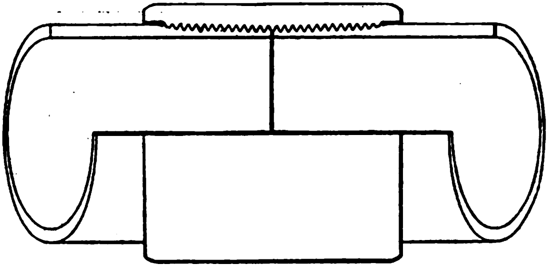
With Patented Reinforcing Couplings

Nominal Internal Diameter		External Diameter		Thickness		Weight		No. of Thr'ds per Inch of Screw	Couplings			
									External Diameter		Length	
Ins.	m/m	Ins.	m/m	In.	m/m	Per Foot, Lbs.	Per Meter, Kilos		Ins.	m/m	Ins.	m/m
2	50.80	2⅜	60.32	.190	4.83	4.53	6.74	11½	2.869	72.87	5⅛	130.18
2½	63.50	2⅞	73.03	.217	5.51	6.35	9.45	11½	3.517	89.33	6⅛	155.58
3	76.20	3½	88.90	.254	6.45	9.00	13.39	10	4.107	104.32	6⅝	168.28
4	101.60	4½	114.30	.271	6.88	12.59	18.74	10	5.215	132.46	7⅛	180.98

All weights and dimensions are nominal.
The permissible variation in weight is 5 per cent. above and 5 per cent. below.
Furnished with threads and couplings and in random lengths unless otherwise ordered.

"NATIONAL" DRIVE PIPE

Fitted with V Threads and National Tube Company's Patent Protecting Sleeve Sockets



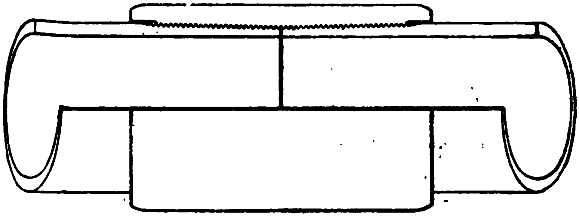
All weights and dimensions are nominal

Size		External Diameter		Thickness		Weight		No. of Thr'ds per Inch of Screw	Couplings		
									External Diameter		Len
Inches	m/m	Ins.	m/m	In.	m/m	Per Foot, Lbs.	Per Meter, Kilos		Ins.	m/m	Ins.
2	50.80	2⅜	60.32	.154	3.91	3.73	5.55	11½	2.92	74.2	3[illegible]
2½	63.50	2⅞	73.03	.203	5.16	5.91	8.80	8	3.49	88.6	4[illegible]
3	76.20	3½	88.90	.216	5.49	7.71	11.47	8	4.11	104.4	4[illegible]
3½	88.90	4	101.60	.226	5.74	9.29	13.83	8	4.72	119.9	4[illegible]
4	101.60	4½	114.30	.237	6.02	11.00	16.37	8	5.22	132.6	4[illegible]
4½	114.30	5	127.00	.247	6.27	12.76	18.99	8	5.72	145.3	4[illegible]
5	127.00	5 9/16	141.29	.258	6.55	14.99	22.31	8	6.41	162.8	5[illegible]
6	152.40	6⅝	168.28	.280	7.11	19.41	28.89	8	7.47	189.7	5[illegible]
7	177.80	7⅝	193.68	.301	7.65	24.02	35.75	8	8.47	215.1	5[illegible]
8	203.20	8⅝	219.08	.277	7.04	25.50	37.95	8	9.59	243.6	6[illegible]
8	203.20	8⅝	219.08	.322	8.18	29.30	43.60	8	9.59	243.6	6[illegible]
8	203.20	8⅝	219.08	.354	8.99	32.33	48.11	8	9.88	251.0	6[illegible]
9	228.60	9⅝	244.48	.342	8.69	34.71	51.65	8	10.59	269.0	6[illegible]
10	254.00	10¾	273.05	.279	7.09	32.63	48.56	8	11.95	303.5	6[illegible]
10	254.00	10¾	273.05	.307	7.80	35.63	53.02	8	11.95	303.5	6[illegible]
10	254.00	10¾	273.05	.365	9.27	41.79	62.19	8	11.95	303.5	6[illegible]
11	279.40	11¾	298.45	.375	9.52	46.95	69.87	8	12.95	328.9	6[illegible]
12	304.80	12¾	323.85	.330	8.38	45.36	67.50	8	13.95	354.3	6[illegible]
12	304.80	12¾	323.85	.375	9.52	51.07	76.00	8	13.95	354.3	6[illegible]
13	330.20	14	355.60	.375	9.52	56.85	84.60	8	15.44	392.2	7[illegible]
14	355.60	15	381.00	.375	9.52	61.01	90.80	8	16.44	417.6	7[illegible]
15	381.00	16	406.40	.375	9.52	65.16	96.97	8	17.44	443.0	7[illegible]
17 OD	431.80	17	431.80	.393	9.98	73.00	108.64	8	18.68	474.5	7[illegible]
18 OD	457.20	18	457.20	.409	10.39	81.00	120.54	8	19.91	505.7	7[illegible]
20 OD	508.00	20	508.00	.409	10.39	90.00	133.94	8	21.91	556.5	7[illegible]

The permissible variation in weight is 5 per cent. above and 5 per below.

Furnished with threads and couplings and in random lengths, unless o wise ordered.

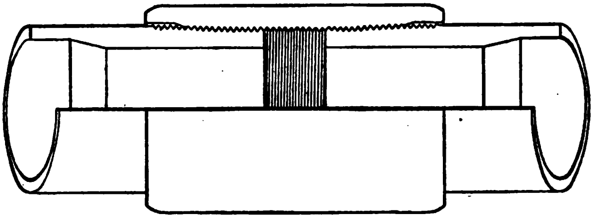
NATIONAL” CALIFORNIA DIAMOND BX DRIVE PIPE



All weights and dimensions are nominal

Size		External Diameter		Thickness		Weight		No of Thr'ds per Inch of Screw	Couplings			
									External Diameter		Length	
Inches	mm.	Ins.	mm.	In.	mm.	Per Foot, Lbs.	Per Meter, Kilos		Ins.	mm.	Ins.	mm.
4¼	107.95	4¾	120.65	.334	8.48	16.00	23.81	10	5.36	136.1	6⅝	168.28
4½	114.30	5	127.00	.247	6.27	12.85	19.12	10	5.69	144.5	6⅛	155.58
4½	114.30	5	127.00	.288	7.32	15.00	22.32	10	5.92	150.4	6⅛	155.58

"NATIONAL" SPECIAL UPSET ROTARY PIPE



Size		External Diameter		Thickness		Weight		No. of Threads per Inch of Screw	Couplings			
									External Diameter		Length	
Ins.	m/m	Ins.	m/m	In.	m/m	Per Foot, Lbs.	Per Mtr., Kilos		Ins.	m/m	Ins.	m/m
2½	63.50	2⅞	73.03	.276	7.01	7.84	11.67	8	3.56	90.4	6⅛	155.6
2½	63.50	2⅞	73.03	.366	9.30	10.00	14.88	8	3.68	93.5	6⅛	155.6
3	76.20	3½	88.90	.300	7.62	10.48	15.60	8	4.25	107.9	6⅛	155.6
4	101.60	4½	114.30	.271	6.88	12.63	18.80	8	5.26	133.6	7⅝	193.7
4	101.60	4½	114.30	.337	8.56	15.32	22.80	8	5.26	133.6	7⅝	193.7
4½	114.30	5	127.00	.306	7.77	15.73	23.41	8	5.75	146.0	7⅝	193.7
5	127.00	5 9/16	141.29	.294	7.47	17.00	25.30	8	6.30	160.0	8⅛	206.4
5	127.00	5 9/16	141.29	.352	8.94	20.00	29.76	8	6.30	160.0	8⅛	206.4
6	152.40	6⅝	168.28	.280	7.11	19.55	29.09	8	7.35	186.7	8⅝	219.1
6	152.40	6⅝	168.28	.344	8.74	23.56	35.06	8	7.35	186.7	8⅝	219.1
6	152.40	6⅝	168.28	.432	10.97	28.95	43.08	8	7.35	186.7	8⅝	219.1

The permissible variation weight is 5 per cent. above and 5 per cent. below.
Furnished with threads and couplings and in random lengths, unless otherwise ordered.

"NATIONAL SHELBY" SEAMLESS INTERIOR UPSET DRILL PIPE

All weights and dimensions are nominal

Size Outside Diameter		Weight (With Couplings)		Thickness		No. of Thr'ds per Inch of Screw	Couplings			
							Outside Diameter		Length	
Ins.	m/m	Per Foot, Pounds	Per Meter, Kilos	In.	m/m		Ins.	m/m	Ins.	m/m
2.375	60.32	4.477	6.66	.1875	4.76	10	2.892	73.46	5⅛	130.18
2.875	73.03	6.002	8.93	.203	5.16	8	3.564	90.53	6⅛	155.58
2.875	73.03	7.841	11.67	.276	7.01	8	3.564	90.53	6⅛	155.58
3.500	88.90	7.939	11.81	.2187	5.55	8	4.248	107.90	6⅛	155.58
4.000	101.60	10.366	15.43	.250	6.35	8	4.771	121.2	7⅛	180.98
4.500	114.30	11.756	17.49	.250	6.35	8	5.256	133.5	7⅝	193.68
4.500	114.30	12.632	18.80	.271	6.88	8	5.256	133.5	7⅝	193.68
4.500	114.30	15.323	22.80	.337	8.56	8	5.256	133.5	7⅝	193.68
5.000	127.00	13.130	19.54	.250	6.35	8	5.756	146.2	7⅝	193.68
5.563	141.30	17.000	25.30	.294	7.47	8	6.303	160.1	8⅛	206.4
5.563	141.30	20.000	29.76	.352	8.94	8	6.303	160.1	8⅛	206.4
6.625	168.28	19.551	29.09	.280	7.11	8	7.350	186.7	8⅝	219.1
6.625	168.28	28.948	43.08	.432	10.97	8	7.350	186.7	8⅝	219.1

The permissible variation in weight is 5 per cent. above and 5 per cent. below.

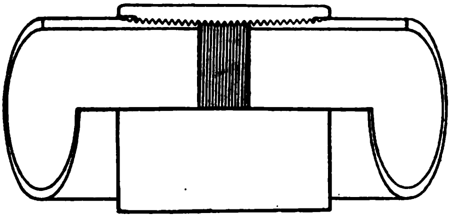
Weight desired must be specified on sizes made in more than one weight.

Furnished with threads and couplings and in random lengths, unless otherwise specified.

Taper of threads is ¾ inch diameter per foot of length (62.5 m/m per meter of length) for all sizes.

"NATIONAL" LINE PIPE

For Natural Gas and Oil

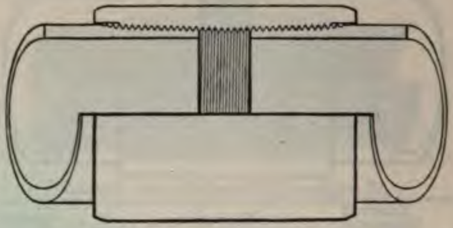


All weights and dimensions are nominal

Size		External Diameter		Thickness		Weight		No. of Threads per Inch of Screw
es	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos	
	3.17	.405	10.29	.068	1.73	.246	.366	27
	6.35	.540	13.72	.088	2.23	.426	.634	18
	9.52	.675	17.15	.091	2.31	.571	.850	18
	12.70	.840	21.34	.109	2.77	.856	1.274	14
	19.05	1.050	26.67	.113	2.87	1.138	1.694	14
	25.40	1.315	33.40	.133	3.38	1.688	2.512	11½
	31.75	1.660	42.16	.140	3.56	2.300	3.423	11½
	38.10	1.900	48.26	.145	3.68	2.748	4.089	11½
	50.80	2⅜	60.32	.154	3.91	3.72	5.54	11½
2½	63.50	2⅞	73.03	.203	5.16	5.88	8.75	8
3	76.20	3½	88.90	.216	5.49	7.68	11.43	8
3½	88.90	4	101.60	.226	5.74	9.26	13.78	8
4	101.60	4½	114.30	.237	6.02	10.98	16.34	8
4½	114.30	5	127.00	.247	6.27	12.74	18.96	8
5	127.00	5 9/16	141.29	.258	6.55	14.97	22.28	8
6	152.40	6⅝	168.28	.280	7.11	19.37	28.83	8
7	177.80	7⅝	193.68	.301	7.65	23.98	35.69	8
8	203.20	8⅝	219.08	.277	7.04	25.41	37.81	8
8	203.20	8⅝	219.08	.322	8.18	29.21	43.47	8
	228.60	9⅝	244.48	.342	8.69	34.61	51.51	8
	254.00	10¾	273.05	.279	7.09	32.52	48.39	8
	254.00	10¾	273.05	.307	7.80	35.50	52.83	8
	254.00	10¾	273.05	.365	9.27	41.64	61.97	8
	279.40	11¾	298.45	.375	9.52	46.81	69.66	8
	304.80	12¾	323.85	.330	8.38	45.22	67.29	8
	304.80	12¾	323.85	.375	9.52	50.92	75.78	8
	330.20	14	355.60	.375	9.52	56.65	84.31	8
	355.60	15	381.00	.375	9.52	60.80	90.48	8
	381.00	16	406.40	.375	9.52	64.96	96.67	8
OD	431.80	17	431.80	.393	9.98	72.77	108.29	8
OD	457.20	18	457.20	.409	10.39	80.66	120.04	8
OD	508.00	20	508.00	.409	10.39	89.79	133.62	8

he permissible variation in weight is 5 per cent. above and 5 per cent. below. Furnished h threads and couplings, and in random lengths, unless otherwise ordered. For cut gths, an extra charge will be made above random lengths. For Galvanized, or coated e an extra charge will be made above Black pipe.

"NATIONAL" ROTARY DRILL PIPE



All weights and dimensions are nominal

Size		External Diameter		Thickness		Weight		No. of Threads per Inch of Screw	Couplings		
									External Diameter		L
Ins.	m/m	Ins.	m/m	In.	m/m	Per Foot, Lbs.	Per Mtr., Kilos		Ins.	m/m	Ins.
*2½	63.50	2⅞	73.03	.276	7.01	7.830	11.65	8	3.60	91.5	51/
*2½	63.50	2⅞	73.03	.366	9.30	10.000	14.88	8	3.69	93.8	55/
*3	76.20	3½	88.90	.368	9.35	12.500	18.60	8	4.25	107.9	61/
4	101.60	4½	114.30	.237	6.02	11.157	16.60	8	5.30	134.7	61/
4	101.60	4½	114.30	.255	6.48	11.916	17.73	8	5.30	134.7	61/
4	101.60	4½	114.30	.269	6.83	12.500	18.60	8	5.30	134.7	61/
*4	101.60	4½	114.30	.337	8.56	15.000	22.32	8	5.30	134.7	61/
4½	114.30	5	127.00	.247	6.27	12.933	19.25	8	5.80	147.4	61/
4½	114.30	5	127.00	.302	7.67	15.500	23.07	8	5.80	147.4	61/
*4½	114.30	5	127.00	.355	9.02	18.000	26.79	8	5.80	147.4	61/
5	127.00	5 9/16	141.29	.258	6.55	15.094	22.46	8	6.33	160.9	71/
5	127.00	5 9/16	141.29	.304	7.72	17.500	26.04	8	6.33	160.9	71/
*5	127.00	5 9/16	141.29	.375	9.52	21.000	31.25	8	6.33	160.9	71/
6	152.40	6⅝	168.28	.280	7.11	19.507	29.03	8	7.40	187.8	71/
6	152.40	6⅝	168.28	.343	8.71	23.500	34.97	8	7.40	187.8	71/
*6	152.40	6⅝	168.28	.432	10.97	29.000	43.16	8	7.40	187.8	71/

*Pipe jarred with hammer while under pressure in addition to hydr test.

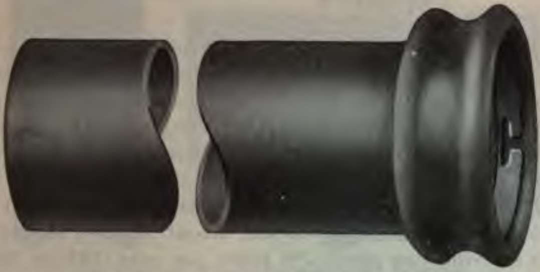
The permissible variation in weight is 5 per cent. above and 5 per cent.

Furnished with threads and couplings and in random lengths, unless wise ordered.

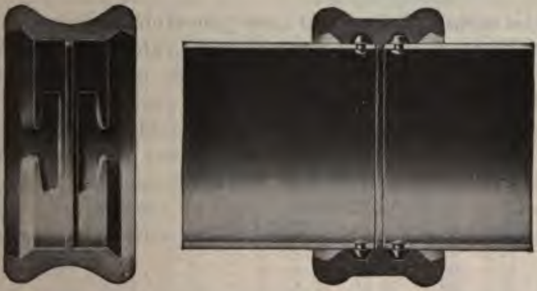
When so ordered, any weight 4½" National Rotary Drill Pipe will be with couplings 5⅛" (130.2 m/m) long, and with a nominal outside diam 5.604 inches (142.3 m/m).

Orders for sizes made in more than one weight must specify the weig sired.

EL LAP-WELDED TUBES FITTED WITH CONVERSE LOCK JOINT HUB



Average length about 18 feet (about 5½ meters)



Sectional view

HE CONVERSE LOCK JOINT HUB is cylindrical; is made of the best foundry
and is cast to uniform patterns, strictly in conformity with diameters
he tubes. As will be seen from the illustration, wedge-shaped spaces are
vided for the lead; recesses into which the lugs or rivets enter, and an
ular ring, against which the ends of the tubes butt, forming a flush and
oth continuous interior of a uniform diameter with the inside of the tubes.

ONVERSE LOCK JOINT TUBES are known by their outside diameters.
y are made of a grade of steel capable of withstanding excessively high
ssure and are finished to such a nicety that they enter the Converse Lock
nt and meet the annular ring of the hub with accuracy. After being

STEEL LAP-WELDED TUBES FITTED WITH CONVERSE LOCK JOINT HUB.—*Continued*

thoroughly tested by hydraulic pressure the plain ends receive two strong rivets each, which enter the recesses in the joint straight; then being locked into position, right or left, as the case may be, the joint is ready to receive the lead calking—no yarn or other gasket being required. For export the hubs are shipped loose to economize freight charges. Both ends of each tube are punched for the rivets, but the rivets are also shipped loose to facilitate nesting. The tubes are manufactured in lengths up to about 20 feet (about 6 meters)—averaging about 17 or 18 feet (about 5 to 5½ meters) over all—according to size—making about 293 joints per mile (182 per kilometer) of pipe, and are furnished Asphalted only or with "National" Coating—see page 198 for coating. Be careful to state whether Asphalted or "National" Coating is required.

These special tubes with Converse Lock Joint Hubs are particularly adapted for the conveyance of water, gas or air, under either light or heavy pressure. They are being largely used, are giving universal satisfaction and are indorsed by many of the most experienced engineers and water and gas works contractors in the world. They can be laid very much more rapidly and cheaply than any other now made, and a very great saving in freight is also effected, on account of their light weight, as compared with old styles of tubes. The great saving in friction by use of these tubes enables smaller sizes to be used and still produce equal results with a consequent saving in first cost.

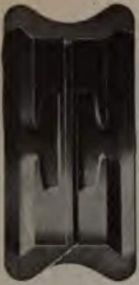
The many desirable features of these tubes recommend them to the careful consideration and investigation of all who are contemplating using piping for constructing or extending water or gas mains, and any information desired will be cheerfully furnished.

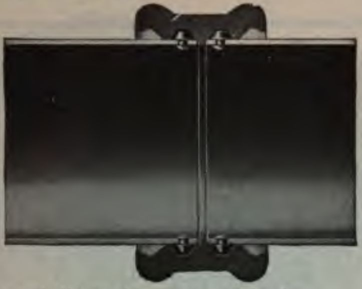
In tests that have been made the joint with the tube has successfully stood a hydraulic pressure of over 1,000 pounds per square inch (70.30 kilos per square centimeter). The tubes are tested to a pressure of from 450 to 700 pounds per square inch (31.64 to 49.21 kilos per square centimeter), depending on the size and thickness.

For outside diameters, thicknesses, approximate weights, etc., see page 221.

We furnish Cast Iron Fittings for Converse Joint Tubes, as also Special Tools for drilling, tapping and calking, etc., for which see pages 226 to 232.

NATIONAL" LAP-WELDED TUBES FITTED WITH CONVERSE LOCK JOINT





All weights and dimensions are nominal

External Diameter		Thickness		Weight Plain Ends		Weight of Hub		Weight of Lead Both Sides of Hub		Wt. Complete, Excluding Lead	
ches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos	Lbs.	Kilos	Lbs.	Kilos	Per Foot, Pounds	Per Meter, Kilos
2	50.8	.095	2.41	1.93	2.87	4.25	1.93	2.00	0.91	2.17	3.23
2½	63.5	.095	2.41	2.44	3.63	5.25	2.38	2.50	1.13	2.73	4.06
3	76.2	.109	2.77	3.37	5.02	8.50	3.86	4.50	2.04	3.84	5.71
3½	88.9	.109	2.77	3.95	5.88	9.25	4.20	5.00	2.27	4.46	6.64
4	101.6	.128	3.25	5.29	7.87	10.50	4.76	6.00	2.72	5.88	8.75
4½	114.3	.128	3.25	5.98	8.90	12.50	5.67	6.50	2.95	6.67	9.93
5	127.0	.134	3.40	6.96	10.36	15.00	6.80	7.50	3.40	7.80	11.61
5½	139.7	.134	3.40	7.68	11.43	16.00	7.26	8.50	3.86	8.57	12.75
6	152.4	.140	3.56	8.76	13.04	19.00	8.62	9.00	4.08	9.82	14.61
6½	165.1	.140	3.56	9.51	14.15	19.50	8.84	10.00	4.54	10.59	15.76
7	177.8	.149	3.78	10.90	16.22	24.00	10.89	11.00	4.99	12.24	18.22
7½	190.5	.149	3.78	11.70	17.41	24.50	11.11	11.00	4.99	13.06	19.44
8	203.2	.158	4.01	13.23	19.69	28.25	12.81	13.00	5.90	14.80	22.93
8	203.2	.185	4.70	15.44	22.98	28.25	12.81	13.00	5.90	17.01	25.31
8½	215.9	.158	4.01	14.08	20.95	29.25	13.27	13.00	5.90	15.70	23.36
8½	215.9	.185	4.70	16.43	24.45	29.25	13.27	13.00	5.90	18.05	26.86
9	228.6	.167	4.24	15.75	23.44	34.50	15.65	17.00	7.71	17.67	26.30
9	228.6	.196	4.98	18.43	27.43	34.50	15.65	17.00	7.71	20.35	30.28
9	228.6	.250	6.35	23.36	34.76	34.50	15.65	17.00	7.71	25.28	37.62
9½	241.3	.167	4.24	16.65	24.78	35.00	15.88	17.00	7.71	18.59	27.67
9½	241.3	.196	4.98	19.48	28.99	35.00	15.88	17.00	7.71	21.42	31.88
9½	241.3	.250	6.35	24.70	36.76	35.00	15.88	17.00	7.71	26.64	39.65
10	254.0	.175	4.45	18.36	27.32	39.00	17.69	18.00	8.16	20.53	30.55
10	254.0	.208	5.28	21.75	32.37	39.00	17.69	18.00	8.16	23.92	35.60
10	254.0	.270	6.86	28.06	41.76	39.00	17.69	18.00	8.16	30.22	44.97
10½	266.7	.175	4.45	19.30	28.72	40.00	18.14	19.00	8.62	21.52	32.03
10½	266.7	.208	5.28	22.86	34.02	40.00	18.14	19.00	8.62	25.09	37.34
10½	266.7	.270	6.86	29.50	43.90	40.00	18.14	19.00	8.62	31.72	47.20
11	279.4	.185	4.70	21.37	31.80	41.50	18.82	20.00	9.07	23.67	35.22
11	279.4	.220	5.59	25.33	37.70	41.50	18.82	20.00	9.07	27.64	41.13
11	279.4	.290	7.37	33.17	49.36	41.50	18.82	20.00	9.07	35.48	52.80
11½	292.1	.185	4.70	22.36	33.28	45.00	20.41	22.00	9.98	24.86	37.00
11½	292.1	.220	5.59	26.50	39.44	45.00	20.41	22.00	9.98	29.00	43.16
11½	292.1	.290	7.37	34.72	51.67	45.00	20.41	22.00	9.98	37.22	55.39

"NATIONAL" LAP-WELDED TUBES FITTED WITH CONVERSE LOCK JOINT.—*Continued*

External Diameter		Thickness		Weight Plain Ends		Weight of Hub		Weight of Lead Both Sides of Hub		Wt. Exclu
Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos	Lbs.	Kilos	Lbs.	Kilos	Per Foot Poun
12	304.8	.194	4.93	24.46	36.40	55.0	24.95	22.0	9.98	27.5
12	304.8	.244	6.20	30.64	45.60	55.0	24.95	22.0	9.98	33.6
12	304.8	.310	7.87	38.70	57.59	55.0	24.95	22.0	9.98	41.7
12½	317.5	.194	4.93	25.50	37.95	58.5	26.53	23.0	10.43	28.7
12½	317.5	.244	6.20	31.94	47.53	58.5	26.53	23.0	10.43	35.1
12½	317.5	.310	7.87	40.36	60.06	58.5	26.53	23.0	10.43	43.6
13	330.2	.202	5.13	27.61	41.09	59.0	26.76	24.0	10.89	30.8
13	330.2	.247	6.27	33.64	50.06	59.0	26.76	24.0	10.89	36.9
13	330.2	.310	7.87	42.01	62.52	59.0	26.76	24.0	10.89	45.2
13½	342.9	.202	5.13	28.69	42.70	62.0	28.12	25.5	11.57	32.1
13½	342.9	.247	6.27	34.96	52.03	62.0	28.12	25.5	11.57	38.4
13½	342.9	.310	7.87	43.67	64.99	62.0	28.12	25.5	11.57	47.1
14	355.6	.210	5.33	30.93	46.03	67.0	30.39	29.0	13.15	34.6
14	355.6	.250	6.35	36.71	54.63	67.0	30.39	29.0	13.15	40.4
14	355.6	.310	7.87	45.33	67.46	67.0	30.39	29.0	13.15	49.0
14½	368.3	.210	5.33	32.05	47.70	69.0	31.30	30.5	13.83	35.8
14½	368.3	.250	6.35	38.05	56.63	69.0	31.30	30.5	13.83	41.8
14½	368.3	.310	7.87	46.98	69.92	69.0	31.30	30.5	13.83	50.8
15	381.0	.222	5.64	35.04	52.15	78.0	35.38	31.0	14.06	39.3
15	381.0	.260	6.60	40.93	60.91	78.0	35.38	31.0	14.06	45.2
15	381.0	.320	8.13	50.17	74.66	78.0	35.38	31.0	14.06	54.5
15½	393.7	.222	5.64	36.22	53.90	81.0	36.74	32.5	14.74	40.7
15½	393.7	.260	6.60	42.32	62.98	81.0	36.74	32.5	14.74	46.8
15½	393.7	.320	8.13	51.88	77.21	81.0	36.74	32.5	14.74	56.3
16	406.4	.234	5.94	39.40	58.63	102.0	46.27	50.0	22.68	45.0
16	406.4	.270	6.86	45.36	67.50	102.0	46.27	50.0	22.68	51.0
16	406.4	.330	8.38	55.23	82.19	102.0	46.27	50.0	22.68	60.8
17	431.8	.240	6.10	42.96	63.93	110.0	49.90	52.0	23.59	49.0
18	457.2	.245	6.22	46.46	69.14	140.0	63.50	60.0	27.22	54.2
18	457.2	.310	7.87	58.57	87.16	140.0	63.50	60.0	27.22	66.3
19	482.6	.259	6.58	51.84	77.15	150.0	68.04	64.0	29.03	60.1
20	508.0	.272	6.91	57.31	85.29	180.0	81.65	74.0	33.57	67.3
20	508.0	.375	9.52	78.60	116.97	180.0	81.65	74.0	33.57	88.6
22	558.8	.301	7.65	69.76	103.82	215.0	97.52	90.0	40.82	81.7
22	558.8	.400	10.16	92.28	137.33	215.0	97.52	90.0	40.82	104.2
24	609.6	.330	8.38	83.42	124.15	275.0	124.74	100.0	45.36	98.7
26	660.4	.362	9.19	99.12	147.51	360.0	163.29	128.0	58.06	119.1
28	711.2	.396	10.06	116.75	173.75	425.0	192.78	154.0	69.85	140.3
30	762.0	.432	10.97	136.42	203.02	525.0	238.14	164.0	74.39	165.5

The permissible variation in weight is 5 per cent. above and 5 per cent. below.

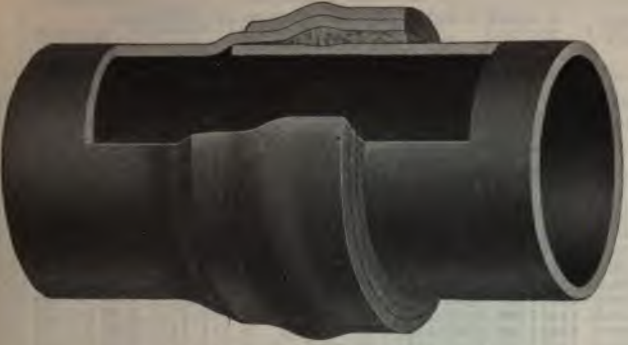
Orders for sizes made in more than one weight must specify the weight desired.

The pipe is furnished black, or dipped, or galvanized, or galvanized and "National" coated single or double wrapped over black or galvanized pipe. furnished.

The quantities of lead indicated are based upon filling the lead space up solid. If y iron borings or other material be introduced the quantity of lead would be reduced c ingly. The exclusive use of lead will always make a better joint than composite packi

In sizes 3" and over this class of pipe is supplied in random lengths averaging abo thus effecting great saving in labor and material required for making joints, as well a the liability of leakage proportionately.

"NATIONAL" MATHESON JOINT PIPE



Matheson Joint Pipe is a pipe with a joint of the bell and spigot type, very similar in appearance to a cast iron pipe joint. There are no loose parts of any kind, the joint being made directly on the pipe. The pipe used in connection with this joint ranges in size from 2 inches to 30 inches (50.80 to 762.00 m/m) outside diameter and the standard thicknesses are much lighter than any other pipe. In order to withstand the varying pressures the pipe may be made of different thicknesses. For list of standard sizes, thicknesses, weights, dimensions and test pressures see table, pages 224 and 225.

The joint is made by belling out or expanding one end of the pipe in such a manner as to permit the bell end to slip over the plain or spigot end of the next length of pipe, leaving enough space between the two for the lead which is to make the joint. After the end of the pipe has been shaped a wrought band is shrunk on the outside of the bell to reinforce it at this point and to keep it in shape to withstand the calking of the lead. The spigot end of the pipe has a recess turned in it which prevents the lead from blowing out or the pipe from pulling out.

The advantages of this joint are that it is so designed as to give a continuous, straight, smooth surface inside, which reduces the friction losses to a minimum. The lead per joint is less than for other lead joint pipes of the same diameter.

By using short lengths of pipe this style of joint permits variations in alignment and grades which are often necessary. This feature alone frequently avoids special fittings and pipe bends.

For very high pressures the joint is reinforced with a clamp and a rubber packing which increase its efficiency so that it becomes as strong as the body of the pipe. After the joint has been finished each piece is tested to a hydrostatic pressure of from 450 to 700 pounds per square inch (31.64 to 49.21 kilos per square c/m) depending on the size and thickness.

The average length of the pipe is 18 feet or about 300 joints per mile. The pipe is furnished black (no coating), dipped, galvanized and dipped, or with our special "National" coating.

We furnish Cast Iron Fittings for Matheson Joint Pipe, as also Special Tools for drilling, tapping, calking, etc., for which see pages 226 to 232.

"NATIONAL" MATHESON JOINT PIPE.—*Continued*

All weights and dimensions are nominal.

External Diameter		Thickness		Outside Diameter of Reinforcing Ring		Length of Joint		Weight Complete with Ring, Excluding Lead		Weight of Lead per Joint		Mill Pres
Ins.	m/m	In.	m/m	Ins.	m/m	Ins.	m/m	Per Foot, Pounds	Per Meter, Kilos	Lbs.	Kilos	Lbs. per Sq.In.
2	50.8	.095	2.41	2.90	74	2.16	54.9	1.95	2.90	1.00	.45	700
2½	63.5	.095	2.41	3.40	86	2.16	54.9	2.46	3.66	1.50	.68	700
3	76.2	.109	2.77	4.00	102	2.26	57.4	3.40	5.05	1.75	.79	700
3½	88.9	.109	2.77	4.50	114	2.26	57.4	3.99	5.93	2.25	1.02	600
4	101.6	.128	3.25	5.13	130	2.32	58.9	5.35	7.96	2.75	1.25	600
4½	114.3	.128	3.25	5.63	143	2.32	58.9	6.04	8.98	3.00	1.36	600
5	127.0	.134	3.40	6.18	157	2.38	60.5	7.03	10.47	3.50	1.59	600
5½	139.7	.134	3.40	6.68	170	2.38	60.5	7.76	11.54	4.00	1.81	600
6	152.4	.140	3.56	7.25	184	2.50	63.5	8.86	13.18	4.75	2.15	600
6½	165.1	.140	3.56	7.75	197	2.50	63.5	9.61	14.31	5.00	2.27	600
7	177.8	.149	3.78	8.32	211	2.58	65.5	11.02	16.41	5.50	2.50	600
7½	190.5	.149	3.78	8.82	224	2.58	65.5	11.83	17.60	6.25	2.84	500
8	203.2	.158	4.01	9.38	238	2.73	69.3	13.39	19.92	6.75	3.06	600
8	203.2	.185	4.70	9.49	241	2.78	70.6	15.62	23.25	6.75	3.06	700
8½	215.9	.158	4.01	9.88	251	2.73	69.3	14.24	21.19	7.00	3.18	600
8½	215.9	.185	4.70	9.99	254	2.78	70.6	16.62	24.74	7.00	3.18	700
9	228.6	.167	4.24	10.44	265	2.73	69.3	15.94	23.72	8.25	3.74	500
9	228.6	.196	4.98	10.55	268	2.90	73.7	18.65	27.76	8.50	3.86	600
9	228.6	.250	6.35	10.77	274	3.07	78.0	23.66	35.21	9.00	4.08	700
9½	241.3	.167	4.24	10.94	278	2.73	69.3	16.84	25.06	9.00	4.08	500
9½	241.3	.196	4.98	11.05	281	2.90	73.7	19.71	29.34	9.00	4.08	600
9½	241.3	.250	6.35	11.27	286	3.07	78.0	25.01	37.22	9.75	4.42	700
10	254.0	.175	4.45	11.50	292	2.82	71.6	18.58	27.65	9.50	4.31	500
10	254.0	.208	5.28	11.63	295	2.85	72.4	22.01	32.75	9.75	4.42	600
10	254.0	.270	6.86	11.88	302	3.06	77.7	28.41	42.28	10.00	4.54	700
10½	266.7	.175	4.45	12.00	305	2.82	71.6	19.52	29.06	9.75	4.42	500
10½	266.7	.208	5.28	12.13	308	2.85	72.4	23.13	34.42	10.00	4.54	600
10½	266.7	.270	6.86	12.38	314	3.06	77.7	29.87	44.45	10.25	4.65	700
11	279.4	.185	4.70	12.57	319	2.91	73.9	21.63	32.19	11.00	4.99	500
11	279.4	.220	5.59	12.71	323	2.93	74.4	25.64	38.16	11.00	4.99	600
11	279.4	.290	7.37	12.99	330	3.17	80.5	33.67	50.10	12.50	5.67	700
11½	292.1	.185	4.70	13.07	332	2.91	73.9	22.63	33.67	11.50	5.22	500
11½	292.1	.220	5.59	13.21	335	2.93	74.4	26.83	39.93	11.50	5.22	600
11½	292.1	.290	7.37	13.49	343	3.17	80.5	35.18	52.35	13.00	5.90	700
12	304.8	.194	4.93	13.63	346	3.00	76.2	24.77	36.87	13.25	6.01	500
12	304.8	.244	6.20	13.83	351	3.40	86.4	31.07	46.24	14.25	6.46	600
12	304.8	.310	7.87	14.09	358	3.76	95.5	39.31	58.50	16.50	7.48	700

"NATIONAL" MATHESON JOINT PIPE.—*Continued*

xternal iameter		Thickness		Outside Diameter of Reinforcing Ring		Length of Joint		Weight Complete with Ring, Excluding Lead		Weight of Lead per Joint		Mill Test Pressure	
s.	m/m	In.	m/m	Ins.	m/m	Ins.	m/m	Per Foot, Pounds	Per Meter, Kilos	Lbs.	Kilos	Lbs. per Sq.In.	Kilos per c/m²
12½	317.5	.194	4.93	14.13	359	3.00	76.2	25.82	38.43	14.25	6.46	500	35.15
12½	317.5	.244	6.20	14.33	364	3.40	86.4	32.39	48.20	15.00	6.80	600	42.18
12½	317.5	.310	7.87	14.59	371	3.76	95.5	40.99	61.00	17.50	7.94	650	45.69
13	330.2	.202	5.13	14.69	373	3.07	78.0	27.97	41.62	15.25	6.92	500	35.15
13	330.2	.247	6.27	14.87	378	3.40	86.3	34.12	50.78	15.50	7.03	600	42.18
13	330.2	.310	7.87	15.12	384	3.76	95.5	42.67	63.50	18.00	8.16	650	45.69
13½	342.9	.202	5.13	15.19	386	3.07	78.0	29.06	43.25	15.50	7.03	500	35.15
13½	342.9	.247	6.27	15.37	390	3.40	86.3	35.46	52.77	16.00	7.26	550	38.66
13½	342.9	.310	7.87	15.62	397	3.76	95.5	44.35	66.00	18.75	8.51	600	42.18
14	355.6	.210	5.33	15.75	400	3.15	80.0	31.34	46.64	17.25	7.82	500	35.15
14	355.6	.250	6.35	15.91	404	3.53	89.7	37.27	55.46	19.25	8.73	550	38.66
14	355.6	.310	7.87	16.15	410	3.84	97.5	46.06	68.55	20.75	9.41	600	42.18
14½	368.3	.210	5.33	16.25	413	3.15	80.0	32.48	48.33	19.00	8.62	500	35.15
14½	368.3	.250	6.35	16.41	417	3.53	89.7	38.62	57.47	20.00	9.07	550	38.66
14½	368.3	.310	7.87	16.65	423	3.84	97.5	47.74	71.05	21.50	9.75	600	42.18
15	381.0	.222	5.64	16.80	427	3.24	82.3	35.52	52.85	19.25	8.73	500	35.15
15	381.0	.260	6.60	16.95	431	3.53	89.7	41.54	61.81	20.25	9.19	550	38.66
15	381.0	.320	8.13	17.19	437	3.84	97.5	50.98	75.87	22.25	10.09	600	42.18
15½	393.7	.222	5.64	17.30	439	3.24	82.3	36.72	54.64	20.00	9.07	500	35.15
15½	393.7	.260	6.60	17.45	443	3.53	89.7	42.94	63.91	21.00	9.53	550	38.66
15½	393.7	.320	8.13	17.69	449	3.84	97.5	52.72	78.46	22.75	10.32	600	42.18
16	406.4	.234	5.94	17.88	454	3.32	84.3	39.96	59.47	22.00	9.98	500	35.15
16	406.4	.270	6.86	18.02	458	3.62	91.9	46.06	68.54	23.25	10.55	550	38.66
16	406.4	.330	8.38	18.26	464	3.75	95.2	56.09	84.69	24.25	11.00	600	42.18
17	431.8	.240	6.10	18.93	481	3.41	86.6	43.58	64.85	23.75	10.77	450	31.63
18	457.2	.245	6.22	19.96	507	3.50	88.9	47.14	70.16	25.75	11.68	450	31.63
18	457.2	.310	7.87	20.22	514	3.87	98.3	59.52	88.57	28.50	12.93	500	35.15
19	482.6	.259	6.58	21.04	534	3.57	90.7	52.62	78.31	29.00	13.15	450	31.63
20	508.0	.272	6.91	22.10	561	3.64	92.5	58.19	86.60	31.00	14.06	450	31.63
20	508.0	.375	9.52	22.51	572	4.17	105.9	79.94	118.97	35.50	16.10	500	35.15
22	558.8	.301	7.65	24.26	616	4.06	103.1	70.94	105.57	40.25	18.26	450	31.63
22	558.8	.400	10.16	24.66	626	4.65	118.1	94.04	139.95	45.50	20.64	500	35.15
24	609.6	.330	8.38	26.42	671	4.26	108.2	84.90	126.34	48.00	21.77	450	31.63
26	660.4	.362	9.19	28.59	726	4.40	111.8	100.92	150.18	55.25	25.06	450	31.63
28	711.2	.396	10.06	30.76	781	4.58	116.3	118.98	177.06	65.00	29.48	450	31.63
30	762.0	.432	10.97	32.95	837	4.75	120.7	139.07	206.96	75.00	34.02	450	31.63

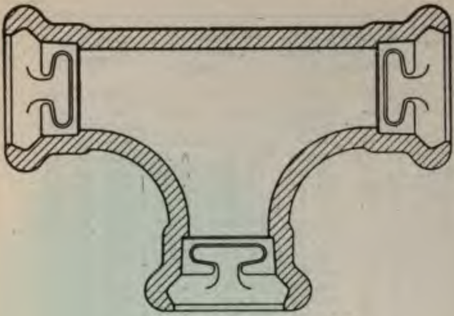
The permissible variation in weight is 5 per cent. above and 5 per cent. below.

Orders for sizes made in more than one weight must specify the weight desired.

The Pipe is furnished black, or dipped, or galvanized, or galvanized and dipped, or "National" coated single or double wrapped over black or galvanized pipe. Lead not furnished.

The quantities of lead indicated are based upon filling the lead-space up solid. If yarn, hemp, iron borings, or other material, be introduced, the quantity of lead would be reduced correspondingly. The exclusive use of lead will always make a better joint than composite packing.

FITTINGS FOR CONVERSE AND MATHESON JOINT TUBES



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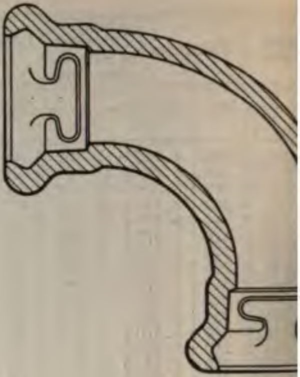
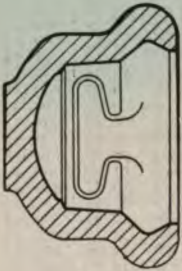
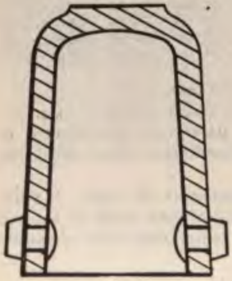


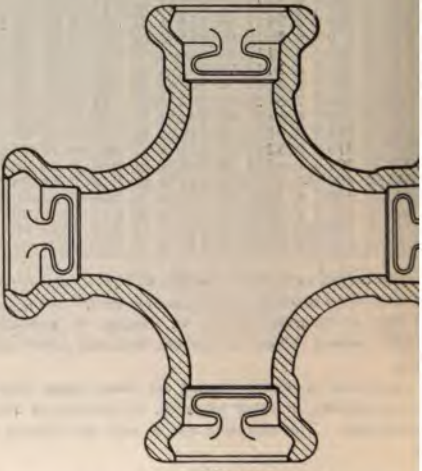
Elbo



Cap



Plug



Cross

Above illustrations show fittings for Converse Joint Tubes. Similar fi but with ends for Matheson Joint Tubes, are also furnished. For sizes and combinations of fittings, see following pages.

tings for Converse and Matheson Joint Tubes.—*Continued*

bmit the following list of ordinary sizes and combinations of fittings Converse and Matheson Joint Tubes:

CROSSES

Size in Inches				
x2	6x3x3x3	8x 8x3x3	10x10x 7x 7	16x16x 6x 6
x2	6x6x2x2	8x 8x4x4	10x10x 8x 8	16x16x 8x 8
x2	6x6x3x3	8x 8x5x5	10x10x10x10	16x16x10x10
x3	6x6x4x4	8x 8x6x6	11x11x 6x 6	16x16x12x12
x2	6x5x5x5	8x 8x7x7	11x11x 8x 8	16x16x14x14
x2	6x6x6x6	8x 8x8x8	11x11x11x11	16x16x16x16
x2	7x3x3x3	9x 9x4x4	12x12x 6x 6	17x17x10x10
x3	7x3x4x4	9x 9x5x5	12x12x 7x 7	17x17x12x12
x3	7x4x3x3	9x 9x6x6	12x12x 8x 8	17x17x14x14
x4	7x4x4x4	9x 9x7x7	12x12x10x10	17x17x17x17
x2	7x3x3x3	9x 9x8x8	12x12x12x12	18x18x10x10
x3	7x7x4x4	9x 9x9x9	14x14x 6x 6	18x18x12x12
x2	7x5x5x5	10x 4x4x4	14x14x 8x 8	18x18x14x14
x3	7x6x6x6	10x 4x5x5	14x14x10x10	18x18x16x16
x2	7x7x7x7	10x 4x6x6	14x12x12x12	18x18x18x18
x3	8x3x3x3	10x 5x4x4	14x14x14x14	20x20x20x20
x4	8x3x4x4	10x 5x5x5	15x15x 6x 6	22x22x22x22
x5	8x3x5x5	10x 5x6x6	15x15x 8x 8	24x24x24x24
x2	8x4x3x3	10x10x4x4	15x15x10x10	26x26x26x26
x3	8x4x4x4	10x10x5x5	15x15x12x12	28x28x28x28
x2	8x4x5x5	10x10x6x6	15x15x15x15	30x30x30x30

re prepared to furnish many other reducing sizes.

equivalents in millimeters of above sizes see tables of Converse and son Joint Tubes, on pages 221, 222, 224 and 225.

FITTINGS FOR CONVERSE AND MATHESON JOINT TUBES.—*Contin*

TEES

SIZE IN INCHES					
2x2x2	6x2x2	8x8x3	10x 4x 6	12x 4x 5	15x1
3x2x2	6x3x3	8x8x4	10x 5x 4	12x 4x 6	15x1
3x3x2	6x4x4	8x8x5	10x 5x 5	12x 4x 7	15x1
3x3x3	6x5x5	8x8x6	10x 5x 6	12x 5x 4	16x1
4x2x2	6x6x6	8x8x7	10x10x 4	12x 5x 5	16x1
4x3x2	7x3x3	8x8x8	10x10x 5	12x12x 4	16x1
4x3x3	7x3x4	9x4x4	10x10x 6	12x12x 5	16x1
4x4x3	7x4x3	9x4x5	10x10x 7	12x12x 6	16x1
4x4x4	7x4x4	9x4x6	10x10x 8	12x12x 7	16x1
5x2x2	7x7x3	9x5x4	10x10x10	12x12x 8	18x1
5x2x3	7x7x4	9x5x5	11x 4x 4	12x12x 9	18x1
5x3x2	7x7x5	9x5x6	11x 4x 6	12x12x10	18x1
5x3x3	7x7x6	9x9x4	11x 5x 5	12x12x12	18x1
5x5x2	7x7x7	9x9x5	11x11x 4	13x13x10	18x1
5x5x3	8x3x3	9x9x6	11x11x 5	13x13x12	20x2
5x5x4	8x3x4	9x9x7	11x11x 6	13x13x13	22x2
5x5x5	8x3x5	9x9x8	11x11x 7	14x14x 8	24x2
6x2x2	8x4x3	9x9x9	11x11x 8	14x14x10	26x2
6x3x2	8x4x4	10x4x4	11x11x11	14x14x12	28x2
6x3x3	8x4x5	10x4x5	12x 4x 4	14x14x14	30x3

ELBOWS

Size, Inches	Deg.	Size, Inches	Deg.	Size, Inches	Deg.	Size, Inches	Deg.	Size, Inches	Deg.	Size, Inche
2x2	90	6x6	90	10x10	90	14x14	90	18x18	90	24x2
2x2	60	6x6	60	10x10	60	14x14	60	18x18	60	24x2
2x2	45	6x6	45	10x10	45	14x14	45	18x18	45	24x2
2x2	22½	6x6	22½	10x10	22½	14x14	22½	18x18	22½	24x2
3x3	90	7x7	90	11x11	90	15x15	90	19x19	90	26x2
3x3	60	7x7	60	11x11	60	15x15	60	19x19	60	26x2
3x3	45	7x7	45	11x11	45	15x15	45	19x19	45	26x2
3x3	22½	7x7	22½	11x11	22½	15x15	22½	19x19	22½	26x2
4x4	90	8x8	90	12x12	90	16x16	90	20x20	90	28x2
4x4	60	8x8	60	12x12	60	16x16	60	20x20	60	28x2
4x4	45	8x8	45	12x12	45	16x16	45	20x20	45	28x2
4x4	22½	8x8	22½	12x12	22½	16x16	22½	20x20	22½	28x2
5x5	90	9x9	90	13x13	90	17x17	90	22x22	90	30x3
5x5	60	9x9	60	13x13	60	17x17	60	22x22	60	30x3
5x5	45	9x9	45	13x13	45	17x17	45	22x22	45	30x3
5x5	22½	9x9	22½	13x13	22½	17x17	22½	22x22	22½	30x3

We are prepared to furnish many other reducing sizes.

For equivalents in millimeters of above sizes see tables of Conver Matheson Joint Tubes, on pages 221, 222, 224 and 225.

Fittings for Converse and Matheson Joint Tubes.—*Continued*

REDUCERS

Size in Inches				
3x2	9x 5	14x 6	17x10	22x20
4x2	9x 6	14x 8	17x12	24x16
4x3	9x 8	14x10	17x14	24x18
5x3	10x 5	14x12	18x12	24x20
5x4	10x 6	15x 8	18x14	26x18
6x2	10x 8	15x10	18x16	26x20
6x3	11x 6	15x12	19x14	26x24
6x4	11x 8	15x14	19x16	28x18
7x4	12x 6	16x 8	20x14	28x20
7x6	12x 8	16x10	20x16	28x24
8x4	12x10	16x12	20x18	30x18
8x5	13x 8	16x14	22x16	30x20
8x6	13x10	17x 8	22x18	30x24

Y's AND CROTCHES

Size in Inches			
2x2x2	8x 8x 8	14x14x14	22x22x22
3x3x3	9x 9x 9	15x15x15	24x24x24
4x4x4	10x10x10	16x16x16	26x26x26
5x5x5	11x11x11	17x17x17	28x28x28
6x6x6	12x12x12	18x18x18	30x30x30
7x7x7	13x13x13	20x20x20	

We are prepared to furnish many reducing sizes

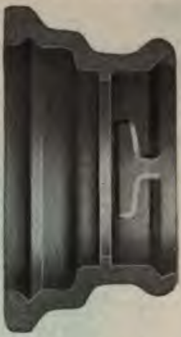
PLUGS CAPS FLANGES

SIZE	SIZE	SIZE	SIZE
2 inch	8 inch	14 inch	20 inch
3 "	9 "	15 "	22 "
4 "	10 "	16 "	24 "
5 "	11 "	17 "	26 "
6 "	12 "	18 "	28 "
7 "	13 "	19 "	30 "

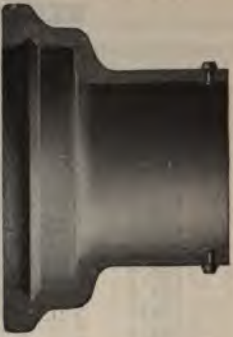
For equivalents in millimeters of above sizes see tables of Converse and atheson Joint Tubes, on pages 221, 222, 224 and 225.

FITTINGS FOR CONVERSE AND MATHESON JOINT TUBES.—*Continued*

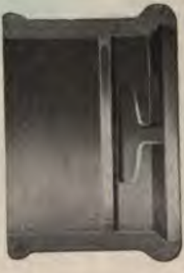
SPECIAL CONNECTORS



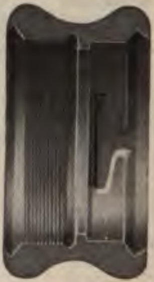
Converse Joint Bell
Cast Iron Pipe Bell



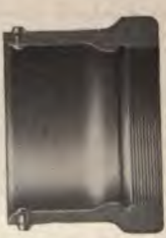
Converse Joint Spigot
Cast Iron Pipe Bell



Converse Joint Bell
Cast Iron Pipe Spigot



Converse Joint Bell
Screw Joint



Converse Joint Spigot
Screw Joint

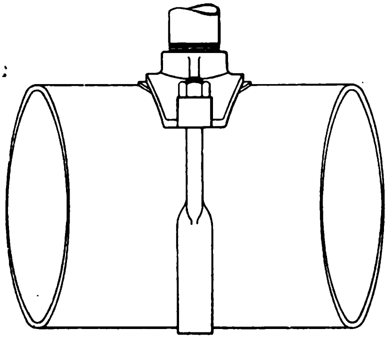
SPECIAL TOOLS FOR DRILLING, TAPPING, CALKING, ETC.

CONVERSE AND MATHESON JOINT TUBES

NATIONAL STANDARD SERVICE CLAMPS

(Without Cocks)

Used when Tapping Under or Not Under Pressure



Size of Pipe, O. D., Inches	Tapped for Pipe, Inches	Size of Pipe, O. D., Inches	Tapped for Pipe, Inches
2	½ to 1	10	¾ to 2½
3	½ to 2	11	¾ to 2½
4	½ to 2½	12	¾ to 2½
5	½ to 2½	13	¾ to 2½
6	½ to 2½	14	¾ to 2½
7	¾ to 2½	15	¾ to 2½
8	¾ to 2½	16	¾ to 2½
9	¾ to 2½		

Tubes 18 inches and larger can be tapped for service connections.

NATIONAL COMBINATION LOCKING AND POURING CLAMPS

Size	Size	Size
For 2-in. O. D. Tubes	For 7-in. O. D. Tubes	For 12-in. O. D. Tubes
For 3-in. O. D. Tubes	For 8-in. O. D. Tubes	For 13-in. O. D. Tubes
For 4-in. O. D. Tubes	For 9-in. O. D. Tubes	For 14-in. O. D. Tubes
For 5-in. O. D. Tubes	For 10-in. O. D. Tubes	For 15-in. O. D. Tubes
For 6-in. O. D. Tubes	For 11-in. O. D. Tubes	

Larger sizes made to order.

SPECIAL TOOLS FOR DRILLING, TAPPING, CALKING, ETC.—*Contin*

NATIONAL DRILLING MACHINE WITH RATC

FOR TAPPING UNDER PRESSURE

Size A, taps for ½, ¾, 1 and 1¼-inch Service.
“ B, “ “ 1½ and 2-inch Service.

FLUTED DRILLS

FOR TAPPING ROUND HOLE IN ANY SIZE OF OUR SPECIAL O. D. TUBE
UNDER PRESSURE

Drill A, for ½-inch Service.
“ A, “ ¾ “ “

Drill A, for 1-inch Service.
“ A, “ 1¼ “ “

NATIONAL DRILLING MACHINE WITH RATC

FOR TAPPING WHEN NOT UNDER PRESSURE

Size C, Tap for 3 to 4-inch O. D. Tubes, inclusive.
“ D, “ “ 6 “ 8 “ “ “ “
“ E, “ “ 9 “ 11 “ “ “ “
“ F, “ “ 12 “ 15 “ “ “ “

FLUTED DRILLS

FOR TAPPING ROUND HOLE IN ANY SIZE OF OUR SPECIAL O. D. TUBES,
NOT UNDER PRESSURE

Drill B, for ½-inch Service.
“ B, “ ¾ “ “
“ B, “ 1 “ “

Drill B, for 1¼-inch Service.
“ B, “ 1½ “ “
“ B, “ 2 “ “

CALKING TOOLS FOR CONVERSE OR MATHE JOINT TUBES

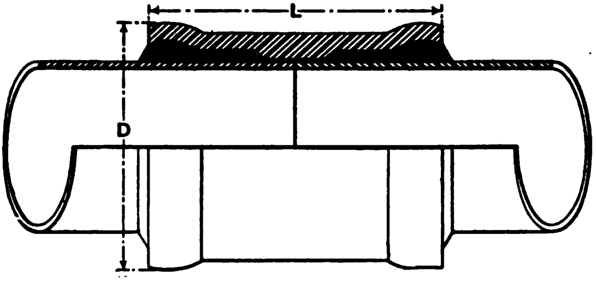
No. 1—Three pieces, per set.
No. 2— “ “ “ “

(When ordering state size of Tubes.)

VALVES AND HYDRANTS

When ordering Valves and Hydrants for Converse or Matheson Tubes do not specify that they are to be fitted with Converse or Matheson (as the case may be) Jo Bell ends will be furnished unless otherwise ordered.

"NATIONAL" LAP-WELDED TUBES, WITH KIMBERLEY COLLARS



The quantities of lead indicated are based upon filling the lead space up solid. If yarn, hemp, iron borings or other material be introduced the quantity of lead would be reduced correspondingly. A little yarn, however, will be necessary to prevent the lead from running into the tubes.

All weights and dimensions are nominal.

External Diameter		Thickness		Weight, Plain Ends		Weight of Collar		Weight of Lead Required		Weight Complete, Excluding Lead	
Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos	Lbs.	Kilos	Lbs.	Kilos	Per Foot, Lbs.	Per Meter, Kilos
6	152.4	.140	3.56	8.76	13.0	15.5	7.0	10.00	4.5	9.62	14.3
6½	165.1	.140	3.56	9.51	14.2	17.0	7.7	11.00	5.0	10.45	15.6
7	177.8	.149	3.78	10.90	16.2	18.5	8.4	13.50	6.1	11.93	17.8
7½	190.5	.149	3.78	11.70	17.4	19.5	8.8	14.50	6.6	12.78	19.0
8	203.2	.158	4.01	13.23	19.7	20.5	9.3	15.50	7.0	14.37	21.4
8	203.2	.185	4.70	15.44	23.0	20.5	9.3	15.50	7.0	16.58	24.7
8½	215.9	.158	4.01	14.08	21.0	22.0	10.0	16.25	7.4	15.30	22.8
8½	215.9	.185	4.70	16.43	24.5	22.0	10.0	16.25	7.4	17.65	26.3
9	228.6	.167	4.24	15.75	23.4	23.0	10.4	17.25	7.8	17.03	25.3
9	228.6	.196	4.98	18.43	27.4	23.0	10.4	17.25	7.8	19.71	29.3
9	228.6	.250	6.35	23.36	34.8	23.0	10.4	17.25	7.8	24.64	36.7
9½	241.3	.167	4.24	16.65	24.8	24.0	10.9	18.25	8.3	17.98	26.8
9½	241.3	.196	4.98	19.48	29.0	24.0	10.9	18.25	8.3	20.81	31.0
9½	241.3	.250	6.35	24.70	36.8	24.0	10.9	18.25	8.3	26.03	38.7
10	254.0	.175	4.45	18.36	27.3	25.5	11.6	19.00	8.6	19.78	29.4
10	254.0	.208	5.28	21.75	32.4	25.5	11.6	19.00	8.6	23.17	34.5
10	254.0	.270	6.86	28.06	41.8	25.5	11.6	19.00	8.6	29.47	43.9

"NATIONAL" LAP-WELDED TUBES, WITH KIMBERLEY COLLARS
Continued

External Diameter		Thickness		Weight, Plain Ends		Weight of Collar		Weight of Lead Required		Weight Com Excludin Lead	
Inches	m/m	In.	m/m	Per Foot, Pounds	Per Meter, Kilos	Lbs.	Kilos	Lbs.	Kilos	Per Foot, Pounds	M K
10½	266.7	.175	4.45	19.30	28.7	26.5	12.0	20.00	9.1	20.77	3
10½	266.7	.208	5.28	22.86	34.0	26.5	12.0	20.00	9.1	24.34	36
10½	266.7	.270	6.86	29.50	43.9	26.5	12.0	20.00	9.1	30.97	46
11	279.4	.185	4.70	21.37	31.8	28.0	12.7	23.25	10.5	22.92	34
11	279.4	.220	5.59	25.33	37.7	28.0	12.7	23.25	10.5	26.88	40
11	279.4	.290	7.37	33.17	49.4	28.0	12.7	23.25	10.5	34.73	51
11½	292.1	.185	4.70	22.36	33.3	29.0	13.2	24.25	11.0	23.97	35
11½	292.1	.220	5.59	26.50	39.4	29.0	13.2	24.25	11.0	28.11	41
11½	292.1	.290	7.37	34.72	51.7	29.0	13.2	24.25	11.0	36.33	54
12	304.8	.194	4.93	24.46	36.4	30.0	13.6	25.50	11.6	26.13	38
12	304.8	.244	6.20	30.64	45.6	30.0	13.6	25.50	11.6	32.30	48
12	304.8	.310	7.87	38.70	57.6	30.0	13.6	25.50	11.6	40.37	60
12½	317.5	.194	4.93	25.50	37.9	32.0	14.5	26.50	12.0	27.28	40
12½	317.5	.244	6.20	31.94	47.5	32.0	14.5	26.50	12.0	33.72	50
12½	317.5	.310	7.87	40.36	60.1	32.0	14.5	26.50	12.0	42.14	62
13	330.2	.202	5.13	27.61	41.1	33.0	15.0	27.50	12.5	29.44	43
13	330.2	.247	6.27	33.64	50.1	33.0	15.0	27.50	12.5	35.48	52
13	330.2	.310	7.87	42.01	62.5	33.0	15.0	27.50	12.5	43.85	65
13½	342.9	.202	5.13	28.69	42.7	34.0	15.4	28.50	12.9	30.58	45
13½	342.9	.247	6.27	34.96	52.0	34.0	15.4	28.50	12.9	36.85	54
13½	342.9	.310	7.87	43.67	65.0	34.0	15.4	28.50	12.9	45.56	67
14	355.6	.210	5.33	30.93	46.0	35.0	15.9	29.50	13.4	32.87	48
14	355.6	.250	6.35	36.71	54.6	35.0	15.9	29.50	13.4	38.66	57
14	355.6	.310	7.87	45.33	67.5	35.0	15.9	29.50	13.4	47.27	70
14½	368.3	.210	5.33	32.05	47.7	36.0	16.3	30.50	13.8	34.05	50
14½	368.3	.250	6.35	38.05	56.6	36.0	16.3	30.50	13.8	40.05	59
14½	368.3	.310	7.87	46.98	69.9	36.0	16.3	30.50	13.8	48.98	72
15	381.0	.222	5.64	35.04	52.1	37.0	16.8	31.50	14.3	37.09	55
15	381.0	.260	6.60	40.93	60.9	37.0	16.8	31.50	14.3	42.99	64
15	381.0	.320	8.13	50.17	74.7	37.0	16.8	31.50	14.3	52.23	77
15½	393.7	.222	5.64	36.22	53.9	38.0	17.2	32.50	14.7	38.34	57
15½	393.7	.260	6.60	42.32	63.0	38.0	17.2	32.50	14.7	44.43	66
15½	393.7	.320	8.13	51.88	77.2	38.0	17.2	32.50	14.7	53.99	80
16	406.4	.234	5.94	39.40	58.6	39.5	17.9	34.36	15.6	41.60	61
16	406.4	.270	6.86	45.36	67.5	39.5	17.9	34.36	15.6	47.55	70
16	406.4	.330	8.38	55.23	82.2	39.5	17.9	34.36	15.6	57.42	85
17	431.8	.240	6.10	42.96	63.9	86.0	39.0	64.00	29.0	47.74	71
18	457.2	.245	6.22	46.46	69.1	90.5	41.1	69.00	31.3	51.49	76
18	457.2	.310	7.87	58.57	87.2	90.5	41.1	69.00	31.3	63.60	94
19	482.6	.259	6.58	51.84	77.2	95.0	43.1	72.50	32.9	57.12	85
20	508.0	.272	6.91	57.31	85.3	100.0	45.4	78.00	35.4	62.87	93
20	508.0	.375	9.52	78.60	117.0	100.0	45.4	78.00	35.4	84.15	125
22	558.8	.301	7.65	69.76	103.8	109.5	49.7	89.50	40.6	75.84	112
22	558.8	.400	10.16	92.28	137.3	109.5	49.7	89.50	40.6	98.36	146
24	609.6	.330	8.38	83.42	124.1	119.0	54.0	97.50	44.2	90.03	134
26	660.4	.362	9.19	99.12	147.5	128.5	58.3	105.50	47.9	106.26	158
28	711.2	.396	10.06	116.75	173.8	138.0	62.6	113.50	51.5	124.41	185
30	762.0	.432	10.97	136.42	203.0	147.5	66.9	121.50	55.1	144.62	215

The permissible variation in weight is 5 per cent. above and 5 per cent. bel
Weight of lead specified is for a complete joint, both sides of collar.

"NATIONAL" WELDED BEDSTEAD TUBING

Outside Diameter		Inside Diameter		Thickness		Weight	
Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
.375	9.53	.245	6.22	.065	1.65	.215	.320
.500	12.70	.370	9.40	.065	1.65	.301	.448
.625	15.88	.487	12.37	.069	1.75	.409	.609
.750	19.05	.594	15.09	.078	1.98	.559	.832
.840	21.34	.684	17.37	.078	1.98	.634	.943
.875	22.23	.719	18.26	.078	1.98	.663	.987
1.000	25.40	.844	21.44	.078	1.98	.768	1.143
1.050	26.67	.894	22.71	.078	1.98	.809	1.204
1.250	31.75	1.072	27.23	.089	2.26	1.103	1.641
1.315	33.40	1.137	28.88	.089	2.26	1.165	1.734
1.500	38.10	1.310	33.27	.095	2.41	1.425	2.121
1.660	42.16	1.470	37.34	.095	2.41	1.587	2.362
1.900	48.26	1.682	42.72	.109	2.77	2.084	3.101
*2.000	50.80	1.782	45.26	.109	2.77	2.201	3.275
2.000	50.80	1.760	44.70	.120	3.05	2.409	3.585
*2.375	60.32	2.115	53.72	.130	3.30	3.117	4.639
2.375	60.32	2.107	53.52	.134	3.40	3.207	4.773
2.500	63.50	2.232	56.69	.134	3.40	3.386	5.039
2.875	73.03	2.509	63.73	.183	4.65	5.261	7.829
3.000	76.20	2.670	67.82	.165	4.19	4.995	7.433

*Will furnish in the lighter weight unless otherwise specified.

The permissible variation in weight is 5 per cent. above and 5 per cent. below.

This tubing furnished with plain ends pointed tool cut, with surface cleaned for enameling purposes, and cut to any length that may be desired.

Bedstead tubing is not subjected to hydraulic test.

All weights and dimensions are nominal.

"NATIONAL" REDRAWN PIPE SPECIALLY RECOMMENDED FOR AMMONIA PURPOSES

Size, Ins.	Outside Diameter		Inside Diameter		Thickness		Weight		Threads per Inch of Screw
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos	
¾	1.050	26.67	0.824	20.93	.113	2.870	1.370	2.039	14
1	1.315	33.40	1.049	26.65	.133	3.378	1.686	2.509	11½
1¼	1.660	42.16	1.380	35.05	.140	3.556	2.297	3.418	11½
1½	1.900	48.26	1.610	40.89	.145	3.683	2.744	4.084	11½
2	2.375	60.32	2.067	52.50	.154	3.912	3.706	5.515	11½

¾ inch to 1½ inch sizes redrawn from larger butt-welded sizes; 2 inch size is lap-welded and made direct.

Manufactured in accordance with specifications for Special Ammonia Pipe No. 1—January 1, 1912.

Air tested on application.

The permissible variation in weight is 5 per cent. above and 5 per cent. below.

Furnished with threads and couplings and in random lengths, unless otherwise ordered.

All weights and dimensions are nominal.

For cut lengths, an extra charge will be made above random lengths.

For Galvanized, or Coated pipe, an extra charge will be made above Black.

"NATIONAL" DRY KILN PIPE

Size, Inches	Outside Diameter		Inside Diameter		Thickness	
	Inches	m/m	Inches	m/m	Inch	m/m
¾	1.050	26.67	0.824	20.93	.113	2.870
1	1.315	33.40	1.049	26.64	.133	3.378
1¼	1.660	42.16	1.380	35.05	.140	3.556

Size, Ins.	Weight		Threads per In. of Screw	Couplings					
				Diameter		Length		Weight	
	Per Foot, Pounds	Per Meter, Kilos		Inches	m/m	Inches	m/m	Lbs.	Kilos
¾	1.140	1.697	14	1.367	34.72	2⅛	53.98	0.374	.170
1	1.697	2.525	11½	1.700	43.18	2⅝	66.67	0.702	.318
1¼	2.304	3.429	11½	2.121	53.87	2⅞	73.02	1.134	.514

The permissible variation in weight is 5 per cent. above and 5 per cent. below.
Furnished with threads and couplings and in random lengths, unless otherwise ordered.
All weights and dimensions are nominal.

"NATIONAL" TUYERE PIPE

Size, Inches	Outside Diameter		Inside Diameter		Thickness		Weight	
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
¾	1.050	26.67	.742	18.85	.154	3.912	1.473	2.192
1	1.315	33.40	.957	24.31	.179	4.547	2.171	3.231
1¼	1.660	42.16	1.278	32.46	.191	4.851	2.996	4.459
1½	1.900	48.26	1.500	38.10	.200	5.080	3.631	5.404

The permissible variation in weight is 5 per cent. above and 5 per cent. below.
Furnished with plain ends and in random lengths, unless otherwise ordered.
This pipe is made in random lengths up to 40 feet.
All weights and dimensions are nominal.

BOILER TUBES

STANDARD SPECIFICATIONS FOR LAP-WELDED AND SEAMLESS BOILER TUBES

As Adopted By
The American Society of Mechanical Engineers.
National Tube Company Merchant and Marine
Steel Boiler Tube Specification No. 2-A, March 1, 1919
Superseding Specification No. 2, January 1, 1916

All Merchant and Marine Boiler Tubes made by the National Tube Company manufactured under the A. S. M. E. Boiler Code [1918 Revision] and the S. T. M. Specification [A-52-18] tests and inspections being identical. For cifications for Locomotive Boiler Tubes, see pages 429 to 433.)

I. MANUFACTURE

Process

*164. (*a*) Lap-welded tubes shall be made of open hearth eel.

(*b*) Seamless tubes shall be made of open hearth steel.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition

165. (*a*) The steel shall conform to the following require- ents as to chemical composition:

Carbon	0.08–0.18 per cent.
Manganese	0.30–0.60 per cent.
Phosphorus	not over 0.04 per cent.
Sulphur	not over 0.045 per cent.

Check Analyses

166. (*a*) Analyses of two tubes in each lot of 250 (or on tal order if less than 250) may be made by the purchaser ich shall conform to the requirements specified in paragraph 5. Drillings for analyses shall be taken from several points und each tube.

(*b*) If the analysis of only one tube does not conform the requirements specified, analyses of two additional tubes m the same lot shall be made, each of which shall conform the requirements specified.

These paragraph numbers refer to serial paragraph numbers, pages 40, nd 42, A. S. M. E. Boiler Code (1918 Ed.).

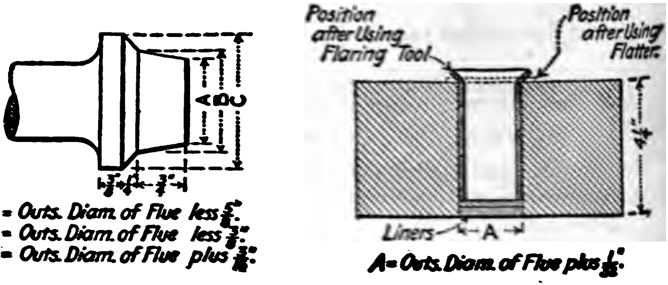
A. S. M. E. Specifications for Boiler Tubes.—*Continued*

III. PHYSICAL PROPERTIES AND TESTS

Flange Test

167. (*a*) For tubes not more than 6-inch diameter, having a thickness less than 10 per cent. of the outside diameter, provided the thickness does not exceed No. 6 B. W. G., a test specimen not less than 4 inches in length shall have a flange turned over at right angles to the body of the tube without cracking or showing any flaw. This flange as measured from the outside of the tube shall have a width of from $\frac{1}{8}$ inch to $\frac{1}{2}$ inch, the width between these limits to be not less than 10 per cent. of the outside diameter of the tube. For other tubes the flange test is not required.

(*b*) In making the flange test, the flaring tool and die block as shown in Fig. 7, may be used.


A
B
C
$\frac{3}{8}$"
$\frac{1}{4}$"
$\frac{3}{4}$"
A = Outs. Diam. of Flue less $\frac{5}{8}$"
B = Outs. Diam. of Flue less $\frac{3}{8}$"
C = Outs. Diam. of Flue plus $\frac{3}{16}$"
Position after Using Flaring Tool
Position after Using Flatter
$4\frac{1}{4}$"
Liners
A
A = Outs. Diam. of Flue plus $\frac{1}{16}$"

Flaring Tool.

Die Block.

Fig. 7. Details of Flaring Tool and Die Block Required for Making Flange Tests of Boiler Tubes

Flattening Tests

168. A test specimen 3 inches in length shall stand flattening between two parallel plates until the distance between the plates is not over five times the wall thickness, without showing cracks or flaws. In the case of lap-welded tubes, the test shall be made with the weld at the point of maximum bend.

Hydrostatic Tests

169. Tubes under 5 inches in diameter shall stand an internal hydrostatic pressure of 1000 pounds per square inch and tubes 5 inches in diameter or over, an internal hydrostatic

A. S. M. E. SPECIFICATIONS FOR BOILER TUBES.—*Continued*

ressure of 800 pounds per square inch, provided the fibre ress corresponding to these pressures does not exceed 16,000 ounds per square inch.

Should the fibre stress corresponding to these pressures xceed 16,000 pounds per square inch, the test pressure shall e determined by the following formula:

$$P = \frac{32000t}{D}$$

where t is the wall thickness in inches; D is the inside diameter in inches. Lap-welded tubes shall be struck near both ends, while under the test pressure, with a 2 pound steel hand hammer, or the equivalent.

> *Note.—For tubes of standard thickness over 6" in diameter the above formula gives a fibre stress over 16,000 pounds per square inch, therefore these sizes are tested to 500 pounds per square inch at the mill.*
>
> *N. T. Co.*

Test Specimens

170. (*a*) All test specimens shall be taken from tubes before being cut to finished lengths and shall be smooth on the ends and free from burrs.

(*b*) All tests shall be made cold.

Number of Tests

171. All tubes shall be subjected to the hydrostatic test. One of each of the physical tests specified shall be made from each of two tubes in each lot of 250 or less.

Retests

172. If the results of the physical tests of only one tube from any lot do not conform to the requirements specified in paragraphs 167 and 168, retests of two additional tubes from the same lot shall be made, each of which shall conform to the requirements specified.

IV. WORKMANSHIP AND FINISH

Workmanship

174. Finished tubes 3½ inches or under in outside diameter shall be circular within 0.02 inch and the mean outside diameter shall not vary more than 0.015 inch from the size ordered. For tubes over 3½ inches in outside diameter, these variations shall not exceed 0.5 per cent. of the outside diameter. All tubes shall be carefully gauged with a B. W. G. gauge and

A. S. M. E. SPECIFICATIONS FOR BOILER TUBES.—*Continued*

shall not be less than the gauge specified. Tubes on whi the standard slot gauge specified will go on tightly at t thinnest point, will be accepted. The length shall not be le but may be 0.125 inch more than that ordered.

Finish

175. The finished tubes shall be free from injurious defect and shall have a workmanlike finish and shall be practically free from kinks, bends and buckles.

V. MARKING

Marking

176. The name or brand of the manufacturer, the material from which it is made, and the pressure in pounds per square inch at which it was tested, shall be legibly stenciled on each tube.

VI. INSPECTION AND REJECTION

Inspection

177. All tests and inspection shall be made at the place of manufacture. The manufacturer of boiler tubes shall furnish the purchaser of each lot of tubes a statement of the kind of material of which the tubes are made, and that the tubes have been tested and have met all the requirements of these rules. This statement shall be furnished to the manufacturer using the tubes.

Rejection

178. Tubes when inserted in the boiler shall stand expanding and beading without showing cracks or flaws, or opening at the weld. Tubes which fail in this manner will be rejected and the manufacturer shall be notified.

NOTE

THE FOLLOWING INFORMATION IS TAKEN FROM PARAGRAPHS 21 AND 22 OF A. S. M. E. BOILER CODE, 1918 EDITION

Tubes for Water-Tube Boilers. The maximum allowable working pressures for tubes used in water-tube boilers shall be for the various diameters and gauges measured by Birmingham wire gauge, as given in table below.

A. S. M. E. SPECIFICATIONS FOR BOILER TUBES.—*Continued*

Tubes for Fire-Tube Boilers. The minimum thicknesses of tubes used in fire-tube boilers measured by Birmingham wire gauge, for maximum allowable working pressures not exceeding 175 lbs. per sq. in., shall be as follows:

Diameter 1 in. or over, but less than 2½ in.........No. 13 B. W. G.
Diameter 2½ in. or over, but less than 3¼ in........No. 12 B. W. G.
Diameter 3¼ in. or over, but less than 4 in.........No. 11 B. W. G.
Diameter 4 in. or over, but less than 5 in.........No. 10 B. W. G.
Diameter 5 in..................................No. 9 B. W. G.

For each increase of one gauge in thickness above that shown in the table, the maximum allowable working pressure will be increased by 200 lbs. divided by the diameter of the tube in inches.

MAXIMUM ALLOWABLE WORKING PRESSURES FOR TUBES FOR WATER-TUBE BOILERS, FOR DIFFERENT DIAMETERS AND GAUGES OF TUBES

Outside Diam. of Tube in Inches D	GAUGE—B. W. G.												
	17 $t=0.058$	16 $t=0.065$	15 $t=0.072$	14 $t=0.083$	13 $t=0.095$	12 $t=0.109$	11 $t=0.120$	10 $t=0.134$	9 $t=0.148$	8 $t=0.165$	7 $t=0.180$	6 $t=0.203$	5 $t=0.220$
½	434	686	938	1334	....	....	....	....	....	....	....	....	....
¾	206	374	542	806	1094	....	....	....	....	....	....	....	....
1	...	218	344	542	758	1010	....	....	....	....	....	....	....
1⅛	...	166	278	454	646	870	1046	....	....	....	....	....	....
1¼	...	124	225	383	557	758	916	1118	....	....	....	....	....
1½	...	...	146	278	422	590	722	890	1058	....	....	....	....
1¾	...	...	...	203	326	470	583	727	871	1046	....	....	....
2	...	...	...	146	254	380	479	605	731	884	1019	....	....
2¼	...	...	...	...	198	310	398	510	622	758	878	1062	....
2½	...	...	...	...	153	254	333	434	535	657	765	931	1053
2¾	...	...	...	...	117	208	280	372	464	575	673	824	935
3	...	...	...	...	...	170	236	320	404	506	596	734	836
3¼	...	...	...	...	...	...	199	276	354	448	531	658	752
3½	...	...	...	...	...	...	167	238	310	398	475	594	681
3¾	...	...	...	...	...	...	139	206	273	355	427	537	619
4	...	...	...	...	...	...	...	178	240	317	385	488	565
4½	...	...	...	...	...	...	...	...	186	254	314	406	474
5	...	...	...	...	...	...	...	...	142	204	258	340	402

$$P=\left(\frac{t—0.039}{D}\right)18000—250$$

Where P = Maximum allowable working pressure, pounds per square inch.
t = Thickness of tube wall, inches.
D = Outside diameter of tube, inches.

Note.—Maximum allowable working pressures for superheater tubes shall be the same as for boiler tubes.

STANDARD SPECIFICATIONS FOR LAP-WELDED AND SEAMLESS BOILER TUBES

AS ADOPTED BY
THE AMERICAN SOCIETY FOR TESTING MATERIALS
AFFILIATED WITH INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS

NATIONAL TUBE COMPANY MERCHANT AND MARINE
STEEL BOILER TUBE SPECIFICATION NO. 2-B, MARCH 1, 1919
SUPERSEDING SPECIFICATION NO. 2, JANUARY 1, 1916

(All Merchant and Marine Boiler Tubes made by the National Tube Company are manufactured under the A. S. T. M. Specification [A-52-18] and the A. S. M. E. Boiler Code [1918 Revision] tests and inspections being identical. For Specifications for Locomotive Boiler Tubes, see pages 429 to 433.)

Material Covered

1. These specifications cover lap-welded and seamless steel boiler tubes, boiler flues, superheater pipes, safe ends and arch tubes for stationary service.

I. MANUFACTURE

Process

2. (*a*) Lap-welded tubes shall be made of open hearth steel.
(*b*) Seamless tubes shall be made of open hearth steel.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition

3. (*a*) The steel shall conform to the following requirements as to chemical composition:

Carbon	0.08–0.18 per cent.
Manganese	0.30–0.60 per cent.
Phosphorus	not over 0.04 per cent.
Sulphur	not over 0.045 per cent.

Check Analyses

4. (*a*) Analyses of two tubes in each lot of 250 steel tubes or less may be made by the purchaser. The chemical composition thus determined shall conform to the requirements specified in Section 3. Drillings for analyses shall be taken from several points around each tube.

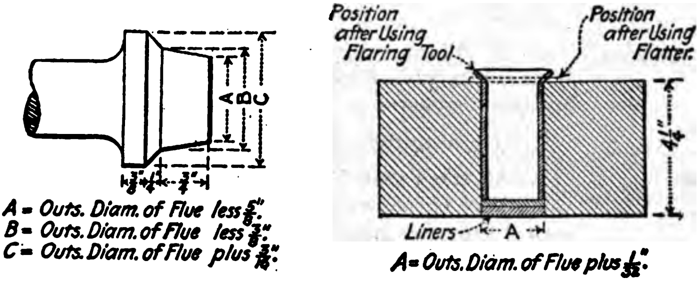
(*b*) If the analysis of only one tube does not conform to the requirements specified, analyses of two additional tubes from the same lot shall be made, each of which shall conform to the requirements specified.

A. S. T. M. SPECIFICATIONS FOR BOILER TUBES.—*Continued*

III. PHYSICAL PROPERTIES AND TESTS

5. (*a*) For tubes not more than 6 inches in diameter having thickness less than 10 per cent. of the oustide diameter, provided the thickness does not exceed No. 6 B. W. G., a test pecimen not less than 4 inches in length shall have a flange urned over at right angles to the body of the tube without howing cracks or flaws. This flange, as measured from the outside diameter of the tube, shall not be less than 10 per cent. of the outside diameter, provided that in no case shall the flange be less than ⅛ inch or greater than ½ inch in width. For all other tubes, the flange test is not required. **Flange Tests**

(*b*) In making the flange test, it is recommended that the flaring tool and die block shown in Fig. 1 be used.


A
B
C
3/8"
1/4"
3/4"
A = Outs. Diam. of Flue less 5/8".
B = Outs. Diam. of Flue less 3/8".
C = Outs. Diam. of Flue plus 3/16".
Position after Using Flaring Tool
Position after Using Flatter.
4 1/4"
Liners
A
A = Outs. Diam. of Flue plus 1/32".

Flaring Tool.

Die Block.

Fig. 1

6. A test specimen 3 inches in length shall stand flattening between parallel plates until the distance between the plates is not over five times the wall thickness, without showing cracks or flaws. For lap-welded tubes, the test shall be made with the weld at the point of maximum bend. **Flattening Tests**

7. Tubes under 5 inches in diameter shall stand an internal hydrostatic pressure of 1000 pounds per square inch, and tubes 5 inches or over in diameter shall stand an internal hydrostatic pressure of 800 pounds per square inch; provided that the fibre stress does not exceed 16,000 pounds per square inch, in **Hydrostatic Tests**

A. S. T. M. SPECIFICATIONS FOR BOILER TUBES.—*Continued*

which case the test pressure shall be determined by the fo lowing formula:

$$P = \frac{32{,}000t}{D}$$

in which P = the pressure in pounds per square inch, t = th thickness of wall in inches, and D = the inside diameter tube in inches. Lap-welded tubes shall be struck near bo ends, while under the test pressure, with a 2 pound steel ha hammer or the equivalent.

> *NOTE.—For tubes of standard thickness over 6" in diameter the above formula gives a fibre stress over 16,000 pounds per square inch, therefore these sizes are tested to 500 pounds per square inch at the mill.*
>
> *N. T. Co.*

Test Specimens

8. (*a*) All test specimens shall be taken from tubes befo being cut to finished lengths and shall be smooth on the en and free from burrs.

(*b*) All specimens shall be tested cold.

Number of Tests

9. All tubes shall be subjected to the hydrostatic tes One of each of the physical tests specified shall be made fro each of two tubes in each lot of 250 or less.

Retests

10. If the results of the physical tests of only one tube fro any lot do not conform to the requirements specified in Se tions 5 or 6, retests of two additional tubes from the same lo shall be made, each of which shall conform to the require ments specified.

IV. STANDARD WEIGHTS

Standard Weights

11. The standard weights for tubes of various outside dia meters and thicknesses are as indicated in Table I.

TABLE I.—STANDARD WEIGHTS

LAP-WELDED AND SEAMLESS STEEL BOILER TUBES FOR STATIONARY SERVICE INCLUDING SAFE ENDS, ARCH TUBES AND LARGE BOILER TUBES

THICKNESS		WEIGHT, LBS. PER FT. OF LENGTH Outside Diameter, Inches																						
In.	BWG	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4	4½	5	5¼	5⅜	5½	6	7	8	9	10	11	12	13
0.095	13	1.679	1.932	2.186	....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
0.109	12	1.910	2.201	2.492	2.783	3.074	3.365	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
0.120	11	2.089	2.409	2.729	3.050	3.370	3.691	4.011	4.331	4.652	...	...	...	...	...	...	...	...	...	...	...	...	...	...
0.134	10	2.312	2.670	3.028	3.386	3.743	4.101	4.459	4.817	5.175	5.532	6.249	...	...	...	...	...	...	...	...	...	...	...	...
0.148	9	2.532	2.927	3.322	3.717	4.112	4.508	4.903	5.298	5.693	6.088	6.879	7.669	8.064	8.262	8.459	...	...	...	...	...	...	...	...
0.165	8	...	3.233	....	4.114	4.555	4.995	5.436	5.877	6.317	6.758	7.639	8.520	8.960	9.181	9.401	10.282	12.044	13.607	...	...	...	...	...
0.180	7	....	....	....	4.460	4.940	5.421	5.901	6.382	6.863	7.343	8.304	9.266	9.746	9.987	10.227	11.188	13.110	15.033	16.955	...	...	...	...
0.203	6	....	....	....	4.980	5.522	6.064	6.606	...	...	8.232	9.316	10.400	...	...	...	12.568	14.736	16.904	19.072	21.240	...	...	...
0.220	5	....	....	....	5.357	5.944	6.531	7.119	...	...	...	...	11.231	...	...	...	13.580	15.930	18.280	20.629	22.979	25.329	...	...
0.229	4½	....	....	....	....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	28.788	...
0.238	4	....	....	....	5.749	6.385	7.020	7.656	...	...	...	...	...	...	...	...	14.646	17.188	19.730	22.271	24.813	27.355	...	32.439
0.2485	3½	....	....	....	....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	31.188	...
0.259	3	....	4.815	5.507	6.198	6.890	7.582	8.273	8.965	...	...	...	...	...	...	...	...	...	...	24.179	26.945	29.711	...	35.243
0.2715	2½	....	....	....	....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	....	34.008	...
0.284	2	....	....	....	6.721	...	8.238	8.996	9.754	...	...	...	...	...	...	...	...	...	...	...	29.470	32.503	...	38.569
0.292	1½	....	....	....	....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	36.512	...
0.300	1	....	....	....	7.048	7.849	8.650	9.451	10.252	...	...	...	...	...	...	...	...	...	...	...	...	34.283	...	40.691
0.320	½	....	....	....	....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	39.918	...
0.340	0	....	....	....	....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	45.971

A. S. T. M. SPECIFICATIONS FOR BOILER TUBES.—*Continued*

SMALL SUPERHEATER PIPES
SEAMLESS ONLY

THICKNESS		WEIGHT, LBS. PER FOOT OF LENGTH Outside Diameter, Inches										
In.	B.W.G.	5/8	11/16	3/4	13/16	7/8	15/16	1	1¼	1⅜	1 7/16	1½
0.083	14	0.480	0.535	.....	.....	.....	.....	.....	.....	.....	.....	.....
0.095	13	0.537	0.601	0.664	0.727	.....	.....	.....	.....	.....	.....	.....
0.109	12	.....	.....	0.746	0.818	0.891	.....	.....	.....	.....	.....	.....
0.120	11	.....	.....	.....	0.887	0.967	1.047	1.127	.....	.....	.....	.....
0.134	10	.....	.....	.....	.....	1.060	1.149	1.239	1.597	1.776	1.865	1.954
0.148	9	.....	.....	.....	.....	.....	1.247	1.346	1.741	1.939	2.038	2.137
0.165	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.352

V. WORKMANSHIP AND FINISH

Workmanship

12. (*a*) Finished tubes 3½ inches or under in outside meter shall be circular within 0.02 inch and the mean ou diameter shall not vary more than 0.015 inch from the ordered. For tubes over 3½ inches in outside diameter, t variations shall not exceed 0.5 per cent. of the outside meter.

(*b*) All tubes shall be gauged with a Birmingham gauge and shall not be less than the thickness specified, ex that tubes will be accepted on which the gauge will g tightly at the thinnest point.

(*c*) The length shall not be less, but may be 0.125 more than that ordered.

Finish

13. The finished tubes shall be free from injurious de and distortion, and shall have a workmanlike finish.

VI. MARKING

Marking

14. The name or brand of the manufacturer, the mat from which it is made, and the pressure in pounds at whi was tested, shall be legibly stenciled on each tube.

VII. INSPECTION AND REJECTION

Inspection

15. Inspection and all tests except check analyses shal made at the place of manufacture. The manufacturer s furnish the purchaser of each lot of tubes a statement of kind of material of which the tubes are made, and that tubes have been tested and have met all the requirement the specifications.

A. S. T. M. SPECIFICATIONS FOR BOILER TUBES.—*Continued*

Rejection

16. Tubes when inserted in the boiler shall stand expanding ad beading without showing cracks or flaws, or opening at he weld. Superheater pipes when properly manipulated shall tand all forging, welding and bending operations necessary r application without developing defects. Tubes or supereater pipes which fail in any of the above operations will be ejected, and the manufacturer shall be notified.

NOTE

THE FOLLOWING INFORMATION, REPRINTED BY PERMISSION FROM THE LATEST REVISIONS OF PARAGRAPHS 21 AND 22 OF THE BOILER CODE OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, IS APPENDED TO THESE SPECIFICATIONS AS INFORMATION OF POSSIBLE VALUE TO USERS OF THE SPECIFICATIONS:

MAXIMUM ALLOWABLE WORKING PRESSURES FOR TUBES IN WATER-TUBE AND FIRE-TUBE BOILERS

Tubes for Water-Tube Boilers. The maximum allowable working pressures for tubes used in water-tube boilers shall be, for the various diameters and gauges measured by Birmingham wire gauge, as given in the accompanying table.

Tubes for Fire-Tube Boilers. The minimum thicknesses of tubes used in fire-tube boilers, measured by Birmingham wire gauge, for maximum allowable working pressures not exceeding 175 lbs. per sq. in. shall be as follows:

Diameter 1 in. or over, but less than 2½ in.	No. 13 B. W. G.
Diameter 2½ in. or over, but less than 3¼ in.	No. 12 B. W. G.
Diameter 3¼ in. or over, but less than 4 in.	No. 11 B. W. G.
Diameter 4 in. or over, but less than 5 in.	No. 10 B. W. G.
Diameter 5 in.	No. 9 B. W. G.

For each increase of one gauge in thickness the maximum allowable working pressure will be increased by 200 lbs. divided by the diameter of the tube in inches.

A. S. T. M. SPECIFICATIONS FOR BOILER TUBES.—*Continued*

MAXIMUM ALLOWABLE WORKING PRESSURES FOR TUBES FOR WATER-TUBE BOILERS

FOR DIFFERENT DIAMETERS AND GAUGES OF TUBES

Outside Diam. of Tube, Inches D	Birmingham Wire Gauge												
	17 $t=0.058$	16 $t=0.65$	15 $t=0.072$	14 $t=0.083$	13 $t=0.095$	12 $t=0.109$	11 $t=0.120$	10 $t=0.134$	9 $t=0.148$	8 $t=0.165$	7 $t=0.180$	6 $t=0.203$	5
½	434	686	938	1334	....	....	....	....	....	....	....	....	....
¾	206	374	542	806	1094	....	....	....	....	....	....	....	....
1	....	218	344	542	758	1010	....	....	....	....	....	....	....
1⅛	....	166	278	454	646	870	1046	....	....	....	....	....	....
1¼	....	124	225	383	557	758	916	1118	....	....	....	....	....
1½	....	....	146	278	422	590	722	890	1058	....	....	....	....
1¾	....	....	....	203	326	470	583	727	871	1046	....	....	....
2	....	....	....	146	254	380	479	605	731	884	1019	....	....
2¼	....	....	....	....	198	310	398	510	622	758	878	1062	....
2½	....	....	....	....	153	254	333	434	535	657	765	931	10
2¾	....	....	....	....	117	208	280	372	464	575	673	824	9
3	....	....	....	....	....	170	236	320	404	506	596	734	8
3¼	....	....	....	....	....	....	199	276	354	448	531	658	7
3½	....	....	....	....	....	....	167	238	310	398	475	594	68
3¾	....	....	....	....	....	....	139	206	273	355	427	537	61
4	....	....	....	....	....	....	....	178	240	317	385	488	56
4½	....	....	....	....	....	....	....	....	186	254	314	406	47
5	....	....	....	....	....	....	....	....	142	204	258	340	44

$$P = \left(\frac{t - 0.039}{D}\right) 18000 - 250$$

Where T = Maximum allowable working pressure, pounds per square inch.
t = Thickness of tube wall, inches.
D = Outside diameter of tube, inches.

Note.—Maximum allowable working pressures for superheater tubes shall be the same as for boiler tubes.

"NATIONAL" AMERICAN STANDARD LAP-WELDED BOILER TUBES

Plain ends.

Swelling Tubes, swelled at one end or both ends.

Reducing Tubes at one end, other end plain or swelled.

Outside Diameter		Standard Thickness			Approximate Weight									
					Standard Thickness		One Extra Wire Gauge		Two Extra Wire Gauges		Three Extra Wire Gauges		Four Extra Wire Gauges	
Inches	m/m	Birm. Wire Gauge	Equiv. in Inches	Equiv. in m/m	Per Foot, Pounds	Per Meter, Kilos	Per Foot, Pounds	Per Meter, Kilos	Per Foot, Pounds	Per Meter, Kilos	Per Foot, Pounds	Per Meter, Kilos	Per Foot, Pounds	Per Meter, Kilos
1¾	44.45	13	.095	2.41	1.68	2.50	1.91	2.84	2.09	3.11	2.31	3.44	2.53	3.77
2	50.80	13	.095	2.41	1.93	2.87	2.20	3.27	2.41	3.59	2.67	3.97	2.93	4.36
2¼	57.15	13	.095	2.41	2.19	3.26	2.49	3.71	2.73	4.06	3.03	4.51	3.32	4.94
2½	63.50	12	.109	2.77	2.78	4.14	3.05	4.54	3.39	5.05	3.72	5.54	4.11	6.12
2¾	69.85	12	.109	2.77	3.07	4.57	3.37	5.02	3.74	5.57	4.11	6.12	4.56	6.79
3	76.20	12	.109	2.77	3.37	5.02	3.69	5.49	4.10	6.10	4.51	6.71	5.00	7.44
3¼	82.55	11	.120	3.05	4.01	5.97	4.46	6.64	4.90	7.29	5.44	8.10	5.90	8.78
3½	88.90	11	.120	3.05	4.33	6.44	4.82	7.17	5.30	7.89	5.88	8.75	6.38	9.49
3¾	95.25	11	.120	3.05	4.65	6.92	5.18	7.71	5.69	8.47	6.32	9.41	6.86	10.21
4	101.60	10	.134	3.40	5.53	8.23	6.09	9.06	6.76	10.06	7.34	10.92	8.23	12.25
4½	114.30	10	.134	3.40	6.25	9.30	6.88	10.24	7.64	11.37	8.30	12.35	9.32	13.87
5	127.00	9	.148	3.76	7.67	11.41	8.52	12.68	9.27	13.80	10.40	15.48	11.23	16.71
6	152.40	8	.165	4.19	10.28	15.30	11.19	16.65	12.57	18.70	13.58	20.21	14.65	21.80
7	177.80	8	.165	4.19	12.04	17.92	13.11	19.51	14.74	21.94	15.93	23.71	17.19	25.58
8	203.20	8	.165	4.19	13.81	20.55	15.03	22.37	16.90	25.15	18.28	27.20	19.73	29.36
9	228.60	7	.180	4.57	16.96	25.24	19.07	28.38	20.63	30.70	22.27	33.14	24.18	35.98
10	254.00	6	.203	5.16	21.24	31.61	22.98	34.20	24.81	36.92	26.95	40.11	29.47	43.85
11	279.40	5	.220	5.59	25.33	37.70	27.36	40.72	29.71	44.21	32.50	48.37	34.28	51.02
12	304.80	4½	.229	5.82	28.79	42.84	31.19	46.42	34.01	50.61	36.51	54.33	39.92	59.40
13	330.20	4	.238	6.05	32.44	48.28	35.24	52.44	38.57	57.40	40.69	60.56	45.97	68.41

Under the A. S. M. E. Specification, to which all of our American Standard merchant boiler tubes are manufactured, the gauge ordered is the lightest weight we may ship. As it is impossible to manufacture to an exact weight, the necessary variation will be represented by overweight. Tubes may vary in weight but will not be lighter than the weight of the gauge ordered.

Sizes smaller than 1¾" O. D. can be furnished Cold Drawn Seamless Steel if required.

Other diameters and thicknesses can be furnished when required.

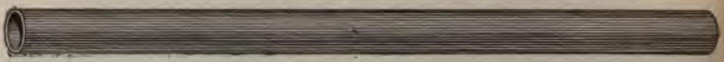
For European Standard Lap-Welded Boiler Tubes see following pages.

When no thickness is specified, tubes will be supplied of the wire gauge named in first column, i. e., Standard Thickness.

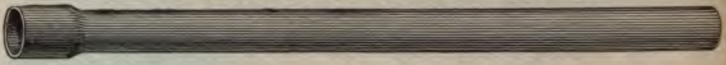
For Locomotive Boiler Tubes, see pages 433 to 436.

"NATIONAL" EUROPEAN STANDARD LAP-WELDED BOILER TUBES

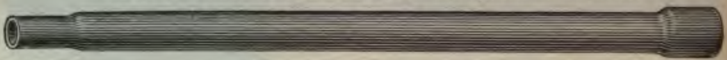
Plain ends.



Swelling Tubes, swelled at one or both ends.



Reducing Tubes at one end, other end plain or swelled.



Nominal Outside Diameter		Usual Thickness			Approximate Weight									
					Usual Wire Gauge		1 Extra Wire Gauge		2 Extra Wire Gauges		3 Extra Wire Gauges		4 Extra Wire Gauges	
Inches	m/m	Imper. Wire Gauge	Equiv. in Inches	Equiv. in m/m	Per Foot, Pounds	Per Meter, Kilos	Per Foot, Pounds	Per Meter, Kilos	Per Foot, Pounds	Per Meter, Kilos	Per Foot, Pounds	Per Meter, Kilos	Per Foot, Pounds	Per Meter,
1¾	44.45	13	.092	2.34	1.63	2.43	1.83	2.72	2.02	3.01	2.22	3.30	2.47	3.
2	50.80	12	.104	2.64	2.11	3.14	2.33	3.47	2.56	3.81	2.85	4.24	3.14	4.
2¼	57.15	12	.104	2.64	2.38	3.54	2.64	3.93	2.90	4.32	3.24	4.82	3.57	5.
2½	63.50	11	.116	2.95	2.95	4.39	3.24	4.82	3.62	5.39	4.00	5.95	4.37	6.
2¾	69.85	11	.116	2.95	3.26	4.85	3.58	5.33	4.01	5.97	4.43	6.59	4.84	7.
3	76.20	11	.116	2.95	3.57	5.31	3.93	5.85	4.39	6.53	4.85	7.22	5.31	7.
3¼	82.55	10	.128	3.25	4.27	6.35	4.78	7.11	5.28	7.86	5.78	8.60	6.27	9.
3½	88.90	10	.128	3.25	4.61	6.86	5.16	7.68	5.71	8.50	6.25	9.30	6.78	10.
3¾	95.25	10	.128	3.25	4.95	7.37	5.55	8.26	6.13	9.12	6.72	10.00	7.30	10.
4	101.60	9	.144	3.66	5.93	8.83	6.56	9.76	7.19	10.70	7.81	11.62	8.58	12.
4¼	107.95	9	.144	3.66	6.31	9.39	6.99	10.40	7.66	11.40	8.32	12.38	9.14	13.
4½	114.30	9	.144	3.66	6.70	9.97	7.42	11.04	8.13	12.10	8.83	13.14	9.71	14.
4¾	120.65	8	.160	4.06	7.84	11.67	8.60	12.80	9.35	13.91	10.27	15.28	11.19	16.6
5	127.00	8	.160	4.06	8.27	12.31	9.07	13.50	9.86	14.67	10.84	16.13	11.81	17.5
5¼	133.35	8	.160	4.06	8.70	12.95	9.54	14.20	10.37	15.43	11.41	16.98	12.43	18.5
5½	139.70	7	.176	4.47	10.01	14.90	10.88	16.19	11.97	17.81	13.05	19.42	14.12	21.0
6	152.40	7	.176	4.47	10.95	16.30	11.91	17.72	13.11	19.51	14.29	21.27	15.47	23.0
6½	165.10	7	.176	4.47	11.89	17.69	12.94	19.26	14.24	21.19	15.53	23.11	16.82	25.0
6⅝	168.28	7	.176	4.47	12.12	18.04	13.19	19.63	14.52	21.61	15.84	23.57	17.15	25.5
7	177.80	7	.176	4.47	12.83	19.09	13.96	20.78	15.37	22.87	16.77	24.96	18.16	27.0
7½	190.50	5	.212	5.38	16.50	24.56	18.01	26.80	19.51	29.03	21.29	31.68	23.07	34.3
7⅝	193.68	5	.212	5.38	16.78	24.97	18.32	27.26	19.84	29.53	21.66	32.23	23.47	34.9
8	203.20	5	.212	5.38	17.63	26.24	19.25	28.65	20.85	31.03	22.77	33.89	24.67	36.71
8½	215.90	3	.252	6.40	22.20	33.04	24.24	36.07	26.27	39.10				
8⅝	219.08	3	.252	6.40	22.54	33.54	24.61	36.62	26.67	39.69				
9	228.60	3	.252	6.40	23.54	35.03	25.72	38.28	27.88	41.49				
9½	241.30	3	.252	6.40	24.89	37.04	27.19	40.46	29.48	43.87				
9⅝	244.48	3	.252	6.40	25.23	37.55	27.56	41.01	29.88	44.47				
10	254.00	3	.252	6.40	26.24	39.05	28.66	42.65	31.08	46.25				
10½	266.70	2	.276	7.01	30.14	44.85	32.68	48.63						
10¾	273.05	1	.300	7.62	33.48	49.82								
11	279.40	1	.300	7.62	34.28	51.02								
11½	292.10	1	.300	7.62	35.89	53.41								
12	304.80	1	.300	7.62	37.49	55.79								

Sizes smaller than 1¾″ O. D. can be furnished Cold Drawn Seamless Steel if required.

When no thickness is specified, tubes will be supplied of the wire gauge named in first column, *i. e., Usual Thickness.*

The permissible variation in weight is 5 per cent. above and 5 per cent. below.

For Locomotive Boiler Tubes, see pages 433 to 436.

European Standard Lap-Welded Boiler Tubes.—*Continued*

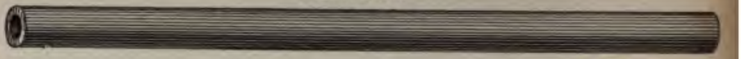
ominal utside ameter		Approximate Weights											
		3/16" Thick (4.76 m/m)		1/4" Thick (6.35 m/m)		5/16" Thick (7.94 m/m)		3/8" Thick (9.53 m/m)		7/16" Thick (11.11 m/m)		1/2" Thick (12.70 m/m)	
	m/m	Per Foot, Pounds	Per Meter, Kilos	Per Foot, Pounds	Per Meter, Kilos	Per Foot, Pounds	Per Meter, Kilos	Per Foot, Pounds	Per Meter, Kilos	Per Foot, Pounds	Per Meter, Kilos	Per Foot, Pounds	Per Meter, Kilos
	44.45	3.13	4.66	4.01	5.97	4.80	7.14	5.51	8.20				
	50.80	3.63	5.40	4.67	6.95	5.63	8.38	6.51	9.69				
	57.15	4.13	6.15	5.34	7.95	6.47	9.63	7.51	11.18				
	63.50	4.63	6.89	6.01	8.94	7.30	10.86	8.51	12.66	9.64	14.35	10.68	15.89
	69 85	5.13	7.63	6.68	9.94	8.14	12.11	9.51	14.15	10.81	16.09	12.02	17.89
	76.20	5.63	8.38	7.34	10.92	8.97	13.35	10.51	15.64	11.97	17.81	13.35	19.87
	82.55	6.13	9.12	8.01	11.92	9.80	14.58	11.51	17.13	13.14	19.55	14.69	21.86
	88.90	6.63	9.87	8.68	12.92	10.64	15.83	12.52	18.63	14.31	21.30	16.02	23.84
	95.25	7.13	10.61	9.35	13.91	11.47	17.07	13.52	20.12	15.48	23.04	17.36	25.84
	101.60	7.63	11.35	10.01	14.90	12.31	18.32	14.52	21.61	16.65	24.78	18.69	27.81
	107.95	8.14	12.11	10.68	15.89	13.14	19.55	15.52	23.10	17.81	26.50	20.03	29.81
	114.30	8.64	12.86	11.35	16.89	13.98	20.81	16.52	24.59	18.98	28.25	21.36	31.79
	120.65	9.14	13.60	12.02	17.89	14.81	22.04	17.52	26.07	20.15	29.99	22.70	33.78
5	127.00	9.64	14.35	12.68	18.87	15.64	23.28	18.52	27.56	21.32	31.73	24.03	35.76
5¼	133.35	10.14	15.09	13.35	19.87	16.48	24.53	19.52	29.05	22.49	33.47	25.37	37.76
5½	139.70	10.64	15.83	14.02	20.86	17.31	25.76	20.53	30.55	23.65	35.20	26.70	39.73
6	152.40	11.64	17.32	15.35	22.84	18.98	28.25	22.53	33.53	25.99	38.68	29.37	43.71
6½	165.10	12.64	18.81	16.69	24.84	20.65	30.73	24.53	36.51	28.33	42.16	32.04	47.68
6⅝	168.28	12.89	19.18	17.02	25.33	21.07	31.36	25.03	37.25	28.91	43.02	32.71	48.68
7	177.80	13.64	20.30	18.02	26.82	22.32	33.22	26.53	39.48	30.66	45.63	34.71	51.66
7½	190.50			19.36	28.81	23.99	35.70	28.54	42.47	33.00	49.11	37.38	55.63
7⅝	193.68			19.69	29.30	24.41	36.33	29.04	43.22	33.58	49.97	38.05	56.63
8	203.20			20.69	30.79	25.66	38.19	30.54	45.45	35.34	52.59	40.05	59.60
8½	215.90			22.03	32.79	27.33	40.67	32.54	48.43	37.67	56.06	42.72	63.58
8⅝	219.08			22.36	33.28	27.74	41.28	33.04	49.17	38.26	56.94	43.39	64.57
9	228.60			23.36	34.76	28.99	43.14	34.54	51.40	40.01	59.54	45.39	67.55
9½	241.30			24.70	36.76	30.66	45.63	36.55	54.39	42.35	63.03	48.06	71.52
9⅝	244.48			25.03	37.25	31.08	46.25	37.05	55.14	42.93	63.89	48.73	72.52
10	254.00			26.03	38.74	32.33	48.11	38.55	57.37	44.68	66.49	50.73	75.50
10½	266.70			27.37	40.73	34.00	50.60	40.55	60.35	47.02	69.98	53.40	79.47
10¾	273.05			28.04	41.73	34.84	51.85	41.55	61.83	48.19	71.72	54.74	81.46
11	279.40			28.70	42.71	35.67	53.08	42.55	63.32	49.35	73.44	56.07	83.44
11	292.10			30.04	44.71	37.34	55.57	44.56	66.31	51.69	76.93	58.74	87.42
12	304 80			31.37	46.68	39.01	58.05	46.56	69.29	54.03	80.41	61.41	91.39

The permissible variation in weight is 5 per cent. above and 5 per cent. below.

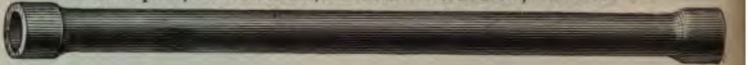
For Locomotive Boiler Tubes, see pages 433 to 436.

"NATIONAL" TUBULAR STAYS

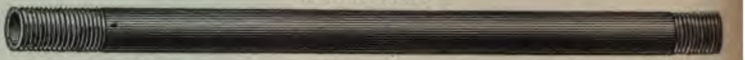
Plain ends.



Ends upset, not screwed; or collars welded on, not screwed.



Screwed ends.



NOTE.—Unless otherwise specified, screwed 4 inches (101.60 m/m) at one end and 7 inches (177.80 m/m) at the other.

Outside Diameters		Thickness		Nominal Weights		Outside Diameters		Thickness		Nominal Weights	
Ins.	m/m	In.	m/m	Per Foot, Pounds	Per Meter, Kilos	Ins.	m/m	In.	m/m	Per Foot, Pounds	Per Meter, Kilos
1½	38.10	3/16	4.76	2.63	3.91	1⅞	47.62	5/16	7.94	5.21	7.75
1½	38.10	¼	6.35	3.34	4.97	1⅞	47.62	⅜	9.52	6.01	8.94
1½	38.10	5/16	7.94	3.96	5.89	1⅞	47.62	7/16	11.11	6.72	10.00
1½	38.10	⅜	9.52	4.51	6.71	1⅞	47.62	½	12.70	7.34	10.92
1⅝	41.27	3/16	4.76	2.88	4.29	2	50.80	3/16	4.76	3.63	5.40
1⅝	41.27	¼	6.35	3.67	5.46	2	50.80	¼	6.35	4.67	6.95
1⅝	41.27	5/16	7.94	4.38	6.52	2	50.80	5/16	7.94	5.63	8.38
1⅝	41.27	⅜	9.52	5.01	7.46	2	50.80	⅜	9.52	6.51	9.69
1⅝	41.27	7/16	11.11	5.55	8.26	2	50.80	7/16	11.11	7.30	10.86
1⅝	41.27	½	12.70	6.01	8.94	2	50.80	½	12.70	8.01	11.92
1¾	44.45	3/16	4.76	3.13	4.66	2⅛	53.97	3/16	4.76	3.88	5.77
1¾	44.45	¼	6.35	4.01	5.97	2⅛	53.97	¼	6.35	5.01	7.46
1¾	44.45	5/16	7.94	4.80	7.14	2⅛	53.97	5/16	7.94	6.05	9.00
1¾	44.45	⅜	9.52	5.51	8.20	2⅛	53.97	⅜	9.52	7.01	10.43
1¾	44.45	7/16	11.11	6.13	9.12	2⅛	53.97	7/16	11.11	7.88	11.73
1¾	44.45	½	12.70	6.68	9.94	2⅛	53.97	½	12.70	8.68	12.92
1⅞	47.62	3/16	4.76	3.38	5.03	2¼	57.15	3/16	4.76	4.13	6.15
1⅞	47.62	¼	6.35	4.34	6.46	2¼	57.15	¼	6.35	5.34	7.95

TUBULAR STAYS.—*Continued*

Outside iameters		Thickness		Nominal Weights		Outside Diameters		Thickness		Nominal Weights	
	m/m	In.	m/m	Per Foot, Pounds	Per Meter, Kilos	Ins.	m/m	In.	m/m	Per Foot, Pounds	Per Meter, Kilos
	57.15	5/16	7.94	6.47	9.63	3	76.20	½	12.70	13.35	19.87
	57.15	⅜	9.52	7.51	11.18	3¼	82.55	3/16	4.76	6.13	9.12
	57.15	7/16	11.11	8.47	12.61	3¼	82.55	¼	6.35	8.01	11.92
	57.15	½	12.70	9.35	13.91	3¼	82.55	5/16	7.94	9.80	14.58
	60.32	3/16	4.76	4.38	6.52	3¼	82.55	⅜	9.52	11.51	17.13
	60.32	¼	6.35	5.67	8.44	3¼	82.55	7/16	11.11	13.14	19.55
	60.32	5/16	7.94	6.88	10.24	3¼	82.55	½	12.70	14.69	21.86
	60.32	⅜	9.52	8.01	11.92	3½	88.90	3/16	4.76	6.63	9.87
	60.32	7/16	11.11	9.05	13.47	3½	88.90	¼	6.35	8.68	12.92
	60.32	½	12.70	10.01	14.90	3½	88.90	5/16	7.94	10.64	15.83
	63.50	3/16	4.76	4.63	6.89	3½	88.90	⅜	9.52	12.52	18.63
	63.50	¼	6.35	6.01	8.94	3½	88.90	7/16	11.11	14.31	21.30
	63.50	5/16	7.94	7.30	10.86	3½	88.90	½	12.70	16.02	23.84
	63.50	⅜	9.52	8.51	12.66	3¾	95.25	3/16	4.76	7.13	10.61
	63.50	7/16	11.11	9.64	14.35	3¾	95.25	¼	6.35	9.35	13.91
	63.50	½	12.70	10.68	15.89	3¾	95.25	5/16	7.94	11.47	17.07
2⅝	66.67	3/16	4.76	4.88	7.26	3¾	95.25	⅜	9.52	13.52	20.12
2⅝	66.67	¼	6.35	6.34	9.44	3¾	95.25	7/16	11.11	15.48	23.04
2⅝	66.67	5/16	7.94	7.72	11.49	3¾	95.25	½	12.70	17.36	25.84
2⅝	66.67	⅜	9.52	9.01	13.41	4	101.60	3/16	4.76	7.63	11.35
2⅝	66.67	7/16	11.11	10.22	15.21	4	101.60	¼	6.35	10.01	14.90
2⅝	66.67	½	12.70	11.35	16.89	4	101.60	5/16	7.94	12.31	18.32
2¾	69.85	3/16	4.76	5.13	7.63	4	101.60	⅜	9.52	14.52	21.61
2¾	69.85	¼	6.35	6.68	9.94	4	101.60	7/16	11.11	16.65	24.78
2¾	69.85	5/16	7.94	8.14	12.11	4	101.60	½	12.70	18.69	27.81
2¾	69.85	⅜	9.52	9.51	14.15	4¼	107.95	3/16	4.76	8.14	12.11
2¾	69.85	7/16	11.11	10.81	16.09	4¼	107.95	¼	6.35	10.68	15.89
2¾	69.85	½	12.70	12.02	17.89	4¼	107.95	5/16	7.94	13.14	19.55
2⅞	73.02	3/16	4.76	5.38	8.01	4¼	107.95	⅜	9.52	15.52	23.10
2⅞	73.02	¼	6.35	7.01	10.43	4¼	107.95	7/16	11.11	17.81	26.50
2⅞	73.02	5/16	7.94	8.55	12.72	4¼	107.95	½	12.70	20.03	29.81
2⅞	73.02	⅜	9.52	10.01	14.90	4½	114.30	3/16	4.76	8.64	12.86
2⅞	73.02	7/16	11.11	11.39	16.95	4½	114.30	¼	6.35	11.35	16.89
3	76.20	3/16	4.76	5.63	8.38	4½	114.30	5/16	7.94	13.98	20.81
3	76.20	¼	6.35	7.34	10.92	4½	114.30	⅜	9.52	16.52	24.59
3	76.20	5/16	7.94	8.97	13.35	4½	114.30	7/16	11.11	18.98	28.25
3	76.20	⅜	9.52	10.51	15.64	4½	114.30	½	12.70	21.36	31.79
3	76.20	7/16	11.11	11.97	17.81						

When ordering stay tubes with upset ends, external or internal, be particular to state outside inside diameter of upset and length of upset. Usual length of upset is 2½" (63.5 m/m).

The permissible variation in weight is 5 per cent. above and 5 per cent. below.

"SHELBY" SEAMLESS MECHANICAL TUBING

Recent years have seen a marked increase in the use of "Shelby" Seamles Steel Tubing in many fields of manufacture. The general high quality and uniformity of the material and the wide range of sizes, shapes and wall thicknesses in which it can be obtained have been responsible for an extensive and increasing use of this product for various mechanical and engineering purposes.

"Shelby" Seamless Steel Tubing is manufactured from various grades o steel of analysis best suited for the purpose. Only material free from laps, seams, cracks and all physical imperfections is used, resulting in tubular products that are of high grade and uniform quality; that are tough and ductile; that have maximum strength and minimum weight; that machine readily and cut free and clean; and that are suitable for bending or forming into specia shapes. Both cold drawn and hot rolled "Shelby" Seamless Tubes are furnished for mechanical purposes and, representing high standards of accuracy in diameters, gauge and wall thicknesses, can often be used to advantage and with economy in the place of solid or forged stock or articles machined therefrom.

"SHELBY" SEAMLESS MECHANICAL TUBING—HOT ROLLED

"Shelby" Hot Rolled Seamless Tubing will be found particularly desirable for mechanical purposes whenever it is necessary to machine either on the outside or inside accurately to finished dimensions. It can be furnished in regular sizes 2 inches to 9 inches in outside diameter in various wall thicknesses. Sizes and wall thicknesses obtainable are subject to the following limitations; it cannot be made less than 2-inch O. D., nor with the wall thickness less than 3% of the outside diameter, provided further that the wall is not thinner than 11 gauge. For example, a tube 2¼-inch O. D. x .080 inch wall would have to be cold drawn, for although the wall thickness is more than 3% of the outside diameter it is thinner than 11 gauge.

This class of material is sold with the understanding on the part of the purchaser that hot rolled tubes will be shipped and the finish, both inside and outside, will be more or less rough and will not compare with regular "Shelby" Cold Drawn Tubes. Hot Rolled Tubes ordinarily are not given any further heat treatment after leaving the hot-mills.

If the Hot Rolled Tubes are to be machined by the Purchaser, the size and thickness to which they are to be finished, as well as the size and thickness required, should be given when ordering.

"SHELBY" SEAMLESS MECHANICAL TUBING.—*Continued*

GENERAL INFORMATION

The Outside Diameters of "Shelby" Seamless Cold Drawn Tubes are irly true to size and seldom vary more than from .005 to .015 of an inch from e true diameter, depending upon the size of the tube. Such variations are ually larger than the true diameter, the greater appearing in the larger sizes. is is due to the wearing of cold drawing dies, and when ordering tubing where tside diameter is required closer than these variations, the above facts should e considered.

The Inside Diameters of "Shelby" Seamless Cold Drawn Tubes have proximately the same variation as the outside diameters, and generally the side diameter is likely to be slightly smaller than the specified diameter. ith heavy walls the variation would be greater, and the inside diameter ould probably be slightly larger than the true diameter.

The Variation in Gauge or Thickness of Wall is always likely to occur in all amless tubes, and is due primarily to the irregular distribution of metal when the billet is being forced over the piercing point during the piercing operation, t which time the original hole is produced in the billet. The variation of distribution of metal seems to vary in different portions of the same billet, and the sult is a slightly different thickness of wall in the same billet, or different icknesses of wall in different billets, both being treated exactly in the same anner. Every means possible is employed to reduce this variation to a inimum, as none of the subsequent operations of manufacture can entirely iminate these differing thicknesses. As the thickness of the wall is reduced hot rolling or cold drawing, the variation is reduced only proportionately, nd when the tube is finished it will have relatively the same percentage of ariation or eccentricity as it had in the form of a pierced billet. The amount f this variation is difficult to determine, as it follows no fixed law, and often oes not occur in the tube at all; but a considerable portion of all seamless ubes are likely to vary 5 per cent. from the true thickness or gauge, and in me cases may vary 10 per cent., but seldom beyond this amount. It is quite vident that this variation or eccentricity of wall must be fully considered in rdering tubes for mechanical purposes where uniformity of wall of tube is ssential, and the necessary allowance must be made for machining where the quirements demand it. In cases of this kind, the purchaser should give the nished size of outside and inside diameter, and tubes will be furnished which ese required sizes.

"Shelby" Seamless Mechanical Tubing.—*Continued*

VARIATIONS OF "SHELBY" SEAMLESS MECHANICAL TUBING

Cold Drawn Mechanical Tubing—Round

Sizes Smaller Than ½ Inch O. D.

Cold drawn seamless tubing is made as small as $\frac{3}{16}$ inch O. D., but in this size not heavier than 16 gauge. This would leave a hole about $\frac{1}{16}$ inch in diameter.

Tubes less than ½ inch O. D. are made by reducing a larger size, and it is not mechanically feasible to use a mandrel to keep the inside diameter true to size. For this reason the inside diameter of tubes under ½ inch O. D. will not, as a rule, be as nearly true to size as the inside diameter of larger tubes.

In general, for tubes less than ½ inch O. D., a variation of 25 per cent. above or below the specified wall thickness is required. For example, the probable variation in wall thickness of a 16 gauge (.065″) tube is 25 per cent. of .065 inch or .016 inch, and the probable limits of wall thickness are then .049 inch minimum and .081 inch maximum.

Sizes ½ Inch to 5½ Inches O. D.

Tubing less than 1½ inches O. D. may vary from exact size to .005 inch over in outside diameter, and from exact size to .005 inch under in inside diameter.

Tubing 1½ inches to but not including 3½ inches in outside diameter may vary from exact size to .010 inch over in outside diameter, and from exact size to .010 inch under in inside diameter.

Tubing 3½ inches to 5½ inches in outside diameter may vary from exact size to .015 inch over in outside diameter and .010 inch over or under the inside diameter.

The wall thickness may be 10 per cent. over or under the specified wall thickness.

The above limits of variation on the inside diameter and wall thickness apply only to tubing having an inside diameter not less than .6 of the outside diameter nor less than ½ inch. Variation in the inside diameter of tubing having an inside diameter less than .6 of the outside diameter or less than ½ inch cannot be accurately controlled.

"SHELBY" SEAMLESS MECHANICAL TUBING.—*Continued*

izes 5½ Inches O. D. to 9 Inches O. D. Made From Pierced Billets

tside diameter variation on tubes whose wall is 5 per cent. or more of the . may be plus or minus .5 of 1 per cent., but in no case will the variation s than plus or minus $\frac{1}{32}$ inch.

tside diameter variation on tubes whose wall thickness is less than 5 per of the O. D. may be plus or minus 1 per cent., but the variation will not s than plus or minus $\frac{1}{32}$ inch.

e variation in wall thickness of tubes 5½ inches to 9 inches O. D. may be or minus 10 per cent. For tubes over 6 inches O. D. the wall thickness be 2½ per cent. or more of the O. D.

HOT ROLLED MECHANICAL TUBING—ROUND

es 3 Inches O. D. and Under: plus $\frac{3}{64}$ inch, minus nothing on the O. D., nothing, minus $\frac{3}{64}$ inch on the I. D.

ises 3 Inches to 5½ Inches O. D.: plus $\frac{1}{16}$ inch, minus nothing on the D., plus nothing, minus $\frac{1}{16}$ inch on the I. D.

The wall thickness, as determined by one-half the difference between the n outside and inside diameters, will not vary more than 12½ per cent.

ple:

Tube specified, 3″ O. D. x 2″ I. D.
Allowable limits, 3.046″ O. D. x 1.954″ I. D.
Mean O. D., 3.023″
Mean I. D., 1.977″
Wall thickness, .523″
Allowable variation in wall thickness, plus or minus 12½ per cent. of .523″, or plus or minus .065″.
Limits on wall thickness, .588″ to .458″.

If necessary, the variations in the diameters given above may be taken over r under on both the O. D. and I. D., or half over and half under on both the . D. and I. D., or any combination of these variations may be taken, but the ll variation must be given.

Sizes 5½ Inches to 9 Inches O. D.: variations on hot rolled tubes 5½ ches O. D. and greater will be the same as those given for cold drawn tubes ½ inches and greater, except that the wall variation may be plus or minus 2½ per cent. The wall for large sized hot rolled tubes must be 3 per cent. or ore of the outside diameter.

In the absence of any special request or knowledge of special conditions, the tandard specifications will apply for all hot-rolled tubes.

The above limits of variation on the inside diameter and wall thickness apply nly to tubes having an inside diameter not less than .6 of the outside diameter.

"SHELBY" SEAMLESS MECHANICAL TUBING.—*Continued*

STRAIGHTNESS OF "SHELBY" SEAMLESS MECHANICAL TUBING

Straightness of "Shelby" Seamless Tubes depends somewhat on size, thickness and anneal, and it is impossible to insure an absolutely stra tube.

All mechanical tubes are carefully straightened in machinery of advan design, but the amount of spring in the tube, due to its shape, makes it exc ingly difficult to control straightness. Where tubes are to be used for hol shafts, hollow pistons, etc., and have to be machined on the outside, this f should be stated when ordering.

LENGTHS OF "SHELBY" SEAMLESS MECHANICAL TUBING

In the manufacture of "Shelby" Seamless Tubes a proportion of the finish under the standard random length of 5 feet, and where the material used in lengths under 5 feet, shipment will be made in either random lengt 5 feet and over, or in multiple lengths at manufacturer's option, witho additional charge, provided purchaser does not order exact lengths and wi furnish with order the multiple required.

Tubing Cut to Length. In the case of square and rectangular tubing speci fied cut to lengths, it should be understood that these tubes cannot always b cut to exact lengths, and that there may be a variation of ⅜-inch over th specified length.

Round tubes, 2½ inches and smaller, will be cut from exact length to 1/16-inch over; tubes larger than 2½ inches will be cut from exact length to ¼-inch over. If exact lengths are necessary it is advisable that they be trimmed by purchaser.

"SHELBY" SEAMLESS MECHANICAL TUBING.—*Continued*

MATERIALS USED IN THE MANUFACTURE OF "SHELBY" SEAMLESS STEEL TUBING

ven principal grades of steels are used in the manufacture of "Shelby" nless Steel Tubes.

Standard Grades		Chemical Composition					
		Carbon %	Manganese %	Phosphorus Max. %	Sulphur Max. %	Nickel %	Chromium %
r Tube	B. T.	.10–.15	.30–.60	.040	.045	......	......
20 Carbon	.17 Carbon	.15–.20	.30–.60	.040	.050	......	......
30 "	.25 "	.20–.30	.35–.65	.040	.050	......	......
40 "	.35 "	.30–.40	.35–.65	.040	.050	......	......
55 "	.50 "	.40–.55	.35–.65	.040	.050	......	......
30 " 3½% Nickel	3½% Nickel	.20–.30	.35–.65	.040	.050	3–3.75	......
.25 " Low Nickel-Chrome	Low Nickel-Chrome	.15–.25	.40–.70	.040	.050	1–1.50	.40–.70

ll of the above grades are standard quality. In addition to using these ndard steels, tubes for special purposes are made from special steels, such higher carbon steels, chrome-vanadium steels, high-carbon-high-chrome ls, etc. The physical qualities of all these materials vary with their heat atment, especially after hot rolled tubes undergo the cold drawing operation ich hardens the steel. The boiler tube grade of steel is especially suitable boiler tubes and for any other tube purposes requiring great ductility. e higher carbon grades of steel tubes are suitable for purposes in which her yield points and tensile strengths are required. The 3½% nickel tubes l other alloy grades are suitable for materials requiring great ductility, nbined with high elastic limits and ultimate strengths.

Iot rolled tubes are not given any further heat treatment after leaving the -mills. Cold drawn tubes are given regular heat treatment unless stated cifically on the order. This heat treatment consists of varying degrees of ieal. For special purposes, the heat treatment of the cold drawn tube is ied to give properties to the tubes suitable for the purposes for which they ultimately to be used.

While the hot rolled tubes are made in seven standard grades of steel and of y other special analysis which may be desired, and any hot rolled tube can cold drawn, however, the cold drawn tube for mechanical purposes can be nmarized, and nearly all of its uses covered, in three grades of cold drawn mless tubing. National Tube Company, therefore, furnishes cold drawn ing in three standard grades: the boiler tube grade, the .17 carbon grade d the .35 carbon grade. Cold drawn tubing desired in any other analysis, n be specially made for these special purposes.

"SHELBY" SEAMLESS MECHANICAL TUBING.—*Continued*

PHYSICAL PROPERTIES OF "SHELBY" SEAMLESS STEEL TUBING

HOT ROLLED SEAMLESS TUBING

Hot rolled seamless tubing cannot be made in all sizes and wall thickn It cannot be made less than 2 inch O. D., nor with the wall thickness less 3 per cent. of the outside diameter, provided further that the wall is not th than 11 gauge.

The surface of hot rolled tubes is a dull bluish-gray, with close-adh scale.

The tensile properties vary with the outside diameter, wall thicknes grade of steel. For the .17 carbon grade, with wall thicknesses $\frac{3}{16}$ inc less, the physical properties approach closely those of temper "U" of th carbon cold drawn tubes (see table page 261). With the wall thickness $\frac{3}{16}$ inch, the physical properties approach closely those of temper "W" c boiler tube grade of cold drawn tubes (see table page 261).

With the higher carbon grades of steel and with the alloy steels, the so many variables that influence the physical results of hot rolled tubing it is not desirable to give a tabulated physical table. These influencing ble factors are chemistry of the steel, outside diameter with the wall se rate of cooling, etc., etc. The physical results obtained from hot rolled t in these high carbon and alloy grades are normal to what would be expect the particular chemistry, but for the tubular section in comparison w solid section for the same analysis steel in the hot finished product, the point, tensile strength and elastic ratio would be slightly higher with c pondingly decreased elongation and reduction of area.

COLD DRAWN SEAMLESS TUBING

The physical properties of cold drawn mechanical tubing are embod the following tabulation which shows the grade of steel, temper, min physical properties, and a short description of the appearance of the together with its application.

Grade of Steel	Treatment	MINIMA					Appearance and Condition
		Yield Point Lbs. per Sq. In.	Tensile Strength Lbs. per Sq. In.	Elongation		Reduction of Area %	
				%2"	%8"		
.17 Carbon	Temper "T" Finish Anneal	45000	58000	17	10	30	Surface dull and fairly scale free. Unless otherwise specified, material is always furnished to this temper.
.17 Carbon	Temper "U" Special Anneal	38000	52000	32	15	35	Surface dull and very slightly scaled. Material of this temper will stand a moderate amount of cold forming.
.17 Carbon	Temper "V" Medium Anneal	35000	50000	45	22	45	Surface dull and slightly scaled. Material of this temper being very soft and ductile, will stand considerable cold forming and is in excellent shape for machining. However, the tool should have a 30 degree top rake, as the chips are long and tough.
.17 Carbon	Unannealed	55000	63000	10	3	18	Surface bright and scale free. Material of maximum strength with but slight ductility.
Boiler Tube	Temper "W"	27000	47000	50	27	50	Surface slightly scaled. This temper is suitable for all purposes; it stands cold forming and manipulation.
Boiler Tube	Temper "X"	28000	50000	52	28	52	Surface considerably scaled. Especially suitable for stay-bolts.
.35 Carbon	Temper "T" Finish Anneal	65000	80000	18	10	20	Surface dull and fairly scale free. Unless otherwise specified material is always furnished to this temper. It is used for mechanical purposes on parts requiring medium high tensile properties but little ductility.
.35 Carbon	Temper "U" Medium Anneal	48000	65000	32	18	32	Surface dull and slightly scaled. This temper is suitable for purposes requiring medium tensile strength and ductility and shock resisting power. This temper will stand reasonable cold forming.
.35 Carbon	Unannealed	70000	85000	10	.	12	Surface bright and scale free. This material has maximum strength but hardly any ductility, and should not be used where subjected to shock. Material, provided it is not subjected to cold working or manipulation, and is to be heated above 500°C. during subsequent manufacture, should be furnished to this temper.

"SHELBY" COLD DRAWN SEAMLESS STEEI ROUND TUBING

Thickness			Outside Diameter in Inches and Millimeters											
B W G	Dec. of an Inch	m/m	½" 12.70 m/m		⅝" 15.88 m/m		¾" 19.05 m/m		⅞" 22.23 m/m		1" 25.40 m/m		1⅛" 28.58 m/m	
			Approximate Weight in Pounds per Foot and Kilos per Meter											
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
20	.035	.89	.17	.25	.22	.33	.27	.40	.31	.46	.36	.54	.41	.61
18	.049	1.24	.24	.36	.30	.45	.37	.55	.43	.64	.50	.74	.56	.83
16	.065	1.65	.30	.45	.39	.58	.47	.70	.56	.83	.65	.97	.74	1.10
14	.083	2.11	.37	.55	.48	.71	.59	.88	.70	1.04	.81	1.21	.92	1.37
13	.095	2.41	.41	.61	.54	.80	.66	.98	.79	1.18	.92	1.37	1.04	1.55
12	.109	2.77	.45	.67	.60	.89	.75	1.12	.89	1.32	1.04	1.55	1.18	1.76
11	.120	3.05	.49	.73	.65	.97	.81	1.21	.97	1.44	1.13	1.68	1.29	1.92
10	.134	3.40	.52	.77	.70	1.04	.88	1.31	1.06	1.58	1.24	1.85	1.42	2.11
In														
5/32	.156	3.97	...	...	...	...	.99	1.47	1.20	1.79	1.41	2.10	1.61	2.40
3/16	.188	4.76	...	...	...	...	1.13	1.68	1.38	2.05	1.63	2.43	1.88	2.80
7/32	.219	5.56	...	...	...	...	...	...	1.53	2.28	1.82	2.71	2.12	3.15
1/4	.250	6.35	...	...	...	...	...	...	...	...	2.00	2.98	2.33	3.47
9/32	.281	7.14	...	...	...	...	...	...	...	...	...	...	...	...
5/16	.313	7.94	...	...	...	...	...	...	...	...	...	...	...	...
3/8	.375	9.53	...	...	...	...	...	...	...	...	...	...	...	...

Thickness			Outside Diameter in Inches and Millimeters										
B W G	Dec. of an Inch	m/m	1⅜" 34.93 m/m		1½" 38.10 m/m		1⅝" 41.28 m/m		1¾" 44.45 m/m		1⅞" 47.63 m/m		5
			Approximate Weight in Pounds per Foot and Kilos per M										
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	L
18	.049	1.24	.69	1.03	.76	1.13	.82	1.22	...	...	...	...	.
16	.065	1.65	.91	1.35	1.00	1.49	1.08	1.61	1.17	1.74	1.26	1.87	1.
14	.083	2.11	1.14	1.70	1.25	1.86	1.37	2.04	1.48	2.20	1.59	2.37	1.
13	.095	2.41	1.30	1.93	1.42	2.11	1.55	2.31	1.68	2.50	1.80	2.68	1.
12	[illegible]	[illegible]	1.47	2.19	1.62	2.41	1.76	2.62	1.91	2.84	2.06	3.07	2.
11	[illegible]	3.05	1.61	2.40	1.77	2.63	1.93	2.87	2.09	3.11	2.25	3.35	2.
10	[illegible]	3.40	1.77	2.65	1.95	2.90	2.13	3.17	2.31	3.44	2.49	3.70	2.
In													
[illegible]	[illegible]	[illegible]	2.03	3.02	2.24	3.33	2.45	3.65	2.66	3.96	2.87	4.27	3.
[illegible]	[illegible]	[illegible]	2.38	3.54	2.63	3.91	2.88	4.29	3.13	4.66	3.38	5.03	3.
[illegible]	[illegible]	[illegible]	2.70	4.02	2.99	4.45	3.28	4.88	3.57	5.31	3.87	5.76	4.
[illegible]	[illegible]	[illegible]	3.00	4.46	3.33	4.96	3.67	5.46	4.00	5.95	4.33	6.44	4.
[illegible]	[illegible]	[illegible]	3.28	4.88	3.66	5.45	4.03	6.00	4.41	6.56	4.78	7.11	5.
[illegible]	[illegible]	[illegible]	3.54	5.27	3.96	5.89	4.38	6.52	4.79	7.13	5.21	7.75	5.
[illegible]	[illegible]	[illegible]	4.00	5.95	4.50	6.70	5.00	7.44	5.50	8.18	6.00	8.93	6.
[illegible]	[illegible]	[illegible]	4.38	6.52	4.96	7.38	5.54	8.25	6.13	9.12	6.71	9.99	7.
[illegible]	[illegible]	[illegible]			5.33	7.93	5.99	8.93	6.67	9.93	7.33	10.91	8.
[illegible]	[illegible]	[illegible]							7.13	10.61	7.88	11.73	8.
[illegible]	[illegible]	[illegible]								:		...	9.1

ELBY" COLD DRAWN SEAMLESS STEEL ROUND TUBING.—*Continued*

kness		Outside Diameter in Inches and Millimeters											
Dec. of an Inch	m/m	2⅛" 53.98 m/m		2¼" 57.15 m/m		2⅜" 60.33 m/m		2½" 63.50 m/m		2⅝" 66.68 m/m		2¾" 69.85 m/m	
		Approximate Weight in Pounds per Foot and Kilos per Meter											
		Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
.065	1.65	1.43	2.13	1.52	2.26	1.60	2.38	1.69	2.51	.....	.....	.....	.....
.083	2.11	1.81	2.69	1.92	2.86	2.03	3.02	2.14	3.18	2.25	3.35	2.36	3.51
.095	2.41	2.06	3.07	2.19	3.26	2.31	3.44	2.44	3.63	2.56	3.81	2.69	4.00
.109	2.77	2.35	3.50	2.49	3.71	2.63	3.91	2.78	4.14	2.93	4.36	3.07	4.57
.120	3.05	2.57	3.82	2.73	4.06	2.89	4.30	3.05	4.54	3.21	4.78	3.37	5.01
.134	3.40	2.85	4.24	3.03	4.51	3.21	4.78	3.39	5.05	3.56	5.30	3.74	5.57
.156	3.97	3.28	4.88	3.49	5.19	3.70	5.51	3.91	5.82	4.12	6.13	4.32	6.43
.188	4.76	3.88	5.77	4.13	6.15	4.38	6.52	4.63	6.89	4.88	7.26	5.13	7.63
.219	5.56	4.48	6.67	4.74	7.05	5.03	7.49	5.32	7.92	5.62	8.36	5.91	8.79
.250	6.35	5.00	7.44	5.33	7.93	5.67	8.44	6.00	8.93	6.33	9.42	6.67	9.92
.281	7.14	5.53	8.23	5.91	8.80	6.28	9.35	6.66	9.91	7.03	10.46	7.41	11.03
.313	7.94	6.04	8.99	6.46	9.61	6.88	10.24	7.29	10.85	7.71	11.47	8.13	12.10
.375	9.53	7.00	10.42	7.50	11.16	8.00	11.91	8.50	12.65	9.00	13.39	9.51	14.15
.438	11.11	7.88	11.73	8.46	12.59	9.04	13.45	9.63	14.33	10.21	15.19	10.79	16.06
.500	12.70	8.67	12.91	9.34	13.90	10.00	14.88	10.67	15.88	11.34	16.88	12.00	17.86
.562	14.29	9.38	13.96	10.13	15.08	10.88	16.19	11.63	17.31	12.38	18.42	13.13	19.54
.625	15.88	10.00	14.88	10.84	16.13	11.67	17.37	12.50	18.60	13.34	19.85	14.17	21.09
.750	19.05	.....	.....	.....	.....	.....	.....	14.00	20.83	15.00	22.32	16.00	23.81

Thickness		Outside Diameter in Inches and Millimeters											
Dec. of an Inch	m/m	2⅞" 73.03 m/m		3" 76.20 m/m		3⅛" 79.38 m/m		3¼" 82.55 m/m		3⅜" 85.73 m/m		3½" 88.90 m/m	
		Approximate Weight in Pounds per Foot and Kilos per Meter											
		Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
.083	2.11	2.47	3.68	....	....	....	....	....	....	....	....	....	....
.095	2.41	2.82	4.20	2.95	4.39	3.07	4.57	3.20	4.76	3.33	4.96	3.45	5.13
.109	2.77	3.22	4.79	3.37	5.02	3.51	5.22	3.66	5.45	3.80	5.66	3.94	5.86
.120	3.05	3.53	5.25	3.69	5.49	3.85	5.73	4.01	5.97	4.17	6.21	4.33	6.44
.134	3.40	3.92	5.83	4.10	6.10	4.28	6.37	4.45	6.64	4.64	6.89	4.82	7.17
.156	3.97	4.53	6.74	4.74	7.05	4.95	7.37	5.16	7.68	5.37	7.99	5.57	8.29
.188	4.76	5.38	8.01	5.63	8.38	5.88	8.75	6.13	9.12	6.38	9.49	6.63	9.87
.219	5.56	6.20	9.23	6.49	9.66	6.78	10.09	7.07	10.52	7.37	10.97	7.66	11.40
.250	6.35	7.00	10.42	7.33	10.91	7.67	11.41	8.00	11.90	8.34	12.41	8.67	12.90
.281	7.14	7.78	11.58	8.16	12.14	8.53	12.69	8.91	13.26	9.28	13.81	9.66	14.38
.313	7.94	8.54	12.71	8.96	13.33	9.38	13.96	9.79	14.57	10.21	15.19	10.63	15.82
.375	9.53	10.00	14.88	10.50	15.63	11.00	16.37	11.50	17.11	12.00	17.86	12.50	18.60
.438	11.11	11.38	16.94	11.96	17.80	12.54	18.66	13.13	19.54	13.71	20.40	14.29	21.27
.500	12.70	12.67	18.86	13.34	19.85	14.00	20.84	14.67	21.83	15.34	22.83	16.00	23.81
.562	14.29	13.88	20.66	14.63	21.77	15.38	22.89	16.13	24.00	16.88	25.12	17.63	26.24
.625	15.88	15.00	22.32	15.84	23.57	16.67	24.81	17.50	26.04	18.34	27.29	19.17	28.53
.750	19.05	17.00	25.30	18.00	26.79	19.00	28.28	20.00	29.76	21.00	31.25	22.00	32.74
.875	22.23	....	....	19.84	29.52	21.00	31.25	22.17	32.99	23.34	34.73	24.51	36.47
1.000	25.40	....	....	21.34	31.76	22.67	33.74	24.01	35.73	25.34	37.71	26.67	39.69

"SHELBY" COLD DRAWN SEAMLESS STEEL ROUND TUBING.—*Cont*

Thickness			Outside Diameter in Inches and Millimeters									
B W G	Dec. of an Inch	m/m	3⅝" 92.08 m/m		3¾" 95.25 m/m		3⅞" 98.43 m/m		4" 101.60 m/m		4⅛" 104.78 m/m	
			Approximate Weights in Pounds per Foot and Kilos per									
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
12	.109	2.77	4.09	6.09	4.24	6.31	....	....	....	....	....	....
11	.120	3.05	4.49	6.68	4.65	6.92	4.81	7.16	4.97	7.40	....	....
10	.134	3.40	4.99	7.43	5.18	7.71	5.35	7.96	5.53	8.23	5.71	8.50
In.												
5/32	.156	3.97	5.78	8.60	5.99	8.91	6.20	9.23	6.41	9.54	6.62	9.85
3/16	.188	4.76	6.88	10.24	7.13	10.61	7.38	10.98	7.63	11.35	7.88	11.73
7/32	.219	5.56	7.95	11.83	8.24	12.26	8.53	12.69	8.82	13.13	9.12	13.57
¼	.250	6.35	9.00	13.39	9.34	13.90	9.67	14.39	10.00	14.88	10.35	15.40
9/32	.281	7.14	10.03	14.93	10.41	15.49	10.78	16.04	11.16	16.61	11.55	17.19
5/16	.313	7.94	11.04	16.43	11.46	17.05	11.88	17.68	12.29	18.29	12.72	18.93
⅜	.375	9.53	13.00	19.35	13.50	20.09	14.00	20.84	14.50	21.58	15.02	22.35
7/16	.438	11.11	14.88	22.14	15.46	23.01	16.04	23.87	16.63	24.75	17.23	25.64
½	.500	12.70	16.67	24.81	17.34	25.80	18.00	26.79	18.67	27.78	19.36	28.81
9/16	,562	14.29	18.38	27.35	19.13	28.47	19.88	29.59	20.63	30.70	21.40	31.85
⅝	.625	15.88	20.00	29.76	20.84	31.01	21.67	32.25	22.50	33.48	23.36	34.76
¾	.750	19.05	23.01	34.24	24.01	35.73	25.00	37.21	26.00	38.69	27.03	40.23
⅞	.875	22.23	25.67	38.20	26.84	39.94	28.00	41.67	29.17	43.41	30.37	45.20
1"	1.000	25.40	28.01	41.68	29.34	43.66	30.67	45.64	32.01	47.64	33.38	49.68

Thickness			Outside Diameter in Inches and Millimeters									
B W G	Dec. of an Inch	m/m	4⅜" 111.13 m/m		4½" 114.30 m/m		4⅝" 117.48 m/m		4¾" 120.65 m/m		4⅞" 123.83 m/m	
			Approximate Weights in Pounds per Foot and Kilos per									
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
10	.134	3.40	6.06	9.02	6.25	9.30	6.42	9.55	6.61	9.84	6.78	10.09
In.												
5/32	.156	3.97	7.04	10.48	7.24	10.77	7.45	11.09	7.66	11.40	7.87	11.71
3/16	.188	4.76	8.38	12.47	8.63	12.84	8.88	13.21	9.13	13.59	9.38	13.96
7/32	.219	5.56	9.71	14.45	9.99	14.87	10.29	15.31	10.58	15.74	10.88	16.19
¼	.250	6.35	11.01	16.38	11.34	16.87	11.68	17.38	12.00	17.86	12.35	18.38
9/32	.281	7.14	12.30	18.30	12.66	18.84	13.05	19.42	13.41	19.96	13.80	20.54
5/16	.313	7.94	13.56	20.18	13.96	20.77	14.39	21.42	14.79	22.01	15.23	22.67
⅜	.375	9.53	16.02	23.84	16.50	24.55	17.02	25.33	17.51	26.06	18.02	26.82
7/16	.438	11.11	18.40	27.38	18.96	28.22	19.57	29.12	20.13	29.96	20.73	30.85
½	.500	12.70	20.69	30.79	21.34	31.75	22.03	32.78	22.67	33.73	23.36	34.76
9/16	.562	14.29	22.90	34.08	23.63	35.17	24.41	36.33	25.13	37.40	25.91	38.56
⅝	.625	15.88	25.03	37.25	25.84	38.45	26.70	39.73	27.51	40.94	28.37	42.22
¾	.750	19.05	29.04	43.22	30.01	44.66	31.04	46.19	32.01	47.63	33.04	49.17
⅞	.875	22.23	32.71	48.68	33.84	50.36	35.04	52.15	36.18	53.84	37.38	55.63
1"	1.000	25.40	36.05	53.65	37.34	55.57	38.72	57.62	40.01	59.54	41.39	61.60

"SHELBY" COLD DRAWN SEAMLESS STEEL ROUND TUBING.—*Continued*

Thickness			Outside Diameter in Inches and Millimeters											
B W G	Dec. of an Inch	m/m	5 1/8" 130.18 m/m		5 1/4" 133.35 m/m		5 3/8" 136.53 m/m		5 1/2" 139.70 m/m		5 3/4" 146.05 m/m		6" 152.40 m/m	
			Approximate Weights in Pounds per Foot and Kilos per Meter											
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
10 In.	.134	3.40	7.14	10.63	7.31	10.88	7.50	11.16	7.67	11.41	8.04	11.96	8.40	12.50
5/32	.156	3.97	8.29	12.34	8.49	12.63	8.70	12.95	8.91	13.26	9.32	13.87	9.74	14.49
3/16	.188	4.76	9.88	14.70	10.13	15.07	10.39	15.46	10.63	15.82	11.17	16.62	11.67	17.37
7/32	.219	5.56	11.46	17.05	11.74	17.47	12.05	17.93	12.32	18.33	12.94	19.26	13.52	20.12
1/4	.250	6.35	13.02	19.38	13.34	19.85	13.68	20.36	14.00	20.83	14.69	21.86	15.35	22.84
9/32	.281	7.14	14.55	21.65	14.91	22.19	15.30	22.77	15.66	23.29	16.43	24.45	17.18	25.57
5/16	.313	7.94	16.06	23.90	16.46	24.49	16.90	25.15	17.30	25.74	18.15	27.01	18.98	28.24
3/8	.375	9.53	19.02	28.31	19.51	29.03	20.03	29.81	20.51	30.52	21.53	32.04	22.53	33.53
7/16	.438	11.11	21.90	32.59	22.46	33.42	23.07	34.33	23.63	35.17	24.82	36.93	25.99	38.68
1/2	.500	12.70	24.70	36.76	25.34	37.71	26.03	38.74	26.67	39.69	28.04	41.73	29.37	43.71
9/16	.562	14.29	27.41	40.79	28.13	41.86	28.91	43.02	29.63	44.10	31.16	46.37	32.67	48.62
5/8	.625	15.88	30.04	44.70	30.84	45.89	31.71	47.19	32.51	48.38	34.21	50.91	35.88	53.40
3/4	.750	19.05	35.04	52.15	36.01	53.59	37.05	55.14	38.01	56.36	40.05	59.60	42.05	62.58
7/8	.875	22.23	39.72	59.11	40.84	60.77	42.05	62.58	43.17	64.25	45.56	67.80	47.89	71.27
1"	1.000	25.40	44.06	65.57	45.34	67.47	46.73	69.54	48.01	71.44	50.73	75.50	53.40	79.47

Thickness			Outside Diameter in Inches and Millimeters											
B W G	Dec. of an Inch	m/m	6 1/4" 158.75 m/m		6 1/2" 165.10 m/m		6 3/4" 171.45 m/m		7" 177.80 m/m		7 1/4" 184.15 m/m		7 1/2" 190.50 m/m	
			Approximate Weights in Pounds per Foot and Kilos per Meter											
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
10 In.	.134	3.40	8.75	13.02	9.11	13.56	9.47	14.09	9.83	14.63	10.18	15.15	10.54	15.68
5/32	.156	3.97	10.15	15.10	10.57	15.73	10.99	16.35	11.40	16.96	11.82	17.59	12.24	18.21
3/16	.188	4.76	12.17	18.11	12.67	18.85	13.18	19.61	13.68	20.36	14.18	21.10	14.68	21.85
7/32	.219	5.56	14.11	21.00	14.69	21.86	15.28	22.74	15.86	23.60	16.45	24.48	17.03	25.34
1/4	.250	6.35	16.02	23.84	16.69	24.84	17.36	25.83	18.02	26.82	18.69	27.81	19.36	28.81
9/32	.281	7.14	17.93	26.68	18.68	27.80	19.43	28.92	20.18	30.03	20.93	31.15	21.68	32.26
5/16	.313	7.94	19.82	29.49	20.65	30.73	21.49	31.98	22.32	33.21	23.15	34.45	23.99	35.70
3/8	.375	9.53	23.53	35.02	24.53	36.50	25.53	37.99	26.53	39.48	27.53	40.97	28.54	42.47
7/16	.438	11.11	27.16	40.42	28.33	42.16	29.50	43.90	30.66	45.63	31.83	47.37	33.00	49.11
1/2	.500	12.70	30.71	45.70	32.04	47.68	33.38	49.67	34.71	51.65	36.05	53.65	37.38	55.62
9/16	.562	14.29	34.17	50.85	35.67	53.08	37.17	55.32	38.67	57.55	40.18	59.80	41.68	62.03
5/8	.625	15.88	37.55	55.88	39.22	58.37	40.88	60.84	42.55	63.32	44.22	65.81	45.89	68.29
3/4	.750	19.05	44.06	65.57	46.06	68.55	48.06	71.52	50.06	74.50	52.07	77.49	54.07	80.47
7/8	.875	22.23	50.23	74.75	52.57	78.23	54.90	81.70	57.24	85.18	59.58	88.67	61.91	92.13
1"	1.000	25.40	56.07	83.44	58.74	87.42	61.41	91.39	64.08	95.36	66.75	99.34	69.42	103.31

"SHELBY" COLD DRAWN SEAMLESS STEEL ROUND TUBING.—*Continued*

Thickness			Outside Diameter in Inches and Millimeters											
B W G	Dec. of an Inch	m/m	7¾" 196.85 m/m		8" 203.20 m/m		8¼" 209.55 m/m		8½" 215.90 m/m		8¾" 222.25 m/m		9" 228.60 m/m	
			Approximate Weights in Pounds per Foot and Kilos per Meter											
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
10	.134	3.40	10.90	16.22	11.26	16.76	11.62	17.29	11.97	17.81	12.33	18.35	12.69	18.88
In. 5/32	.156	3.97	12.65	18.82	13.07	19.45	13.49	20.07	13.90	20.68	14.32	21.31	14.73	21.92
3/16	.188	4.76	15.18	22.59	15.69	23.35	16.19	24.09	16.69	24.84	17.19	25.58	17.69	26.33
7/32	.219	5.56	17.62	26.22	18.20	27.08	18,78	27.95	19.37	28.82	19.95	29.69	20.54	30.56
¼	.250	6.35	20.03	29.81	20.69	30.79	21.36	31.79	22.03	32.78	22.70	33.78	23.36	34.76
9/32	.281	7.14	22.43	33.38	23.19	34.51	23.94	35.63	24.69	36.74	25.44	37.86	26.19	38.98
5/16	.313	7.94	24.82	36.93	25.66	38.18	26.49	39.42	27.33	40.67	28.16	41.90	28.99	43.14
⅜	.375	9.53	29.54	43.96	30.54	45.45	31.54	46.93	32.54	48.42	33.54	49.91	34.54	51.40
7/16	.438	11.11	34.17	50.85	35.34	52.59	36.50	54.32	37.67	56.05	38.84	57.80	40.01	59.54
½	.500	12.70	38.72	57.62	40.05	59.60	41.39	61.59	42.72	63.57	44.06	65.56	45.39	67.54
9/16	.562	14.29	43.18	64.26	44.68	66.49	46.18	68.72	47.69	70.97	49.19	73.20	50.69	75.44
⅝	.625	15.88	47.56	70.78	49.23	73.26	50.90	75.55	52.57	78.23	54.24	80.72	55.90	83.18
¾	.750	19.05	56.07	83.44	58.07	86.42	60.08	89.41	62.08	92.39	64.08	95.36	66.08	98.34
⅞	.875	22.23	64.25	95.62	66.58	99.08	68.92	102.57	71.26	106.05	73.59	109.52	75.93	113.00
1"	1.000	25.40	72.09	107.28	74.76	111.26	77.43	115.23	80.10	119.20	82.77	123.18	85.44	127.15

"SHELBY" COLD DRAWN SEAMLESS STEEL SQUARE TUBING

Thickness			Size (Outside Measurement) in Inches and Millimeters															
B W G	Dec. of an Inch	m/m	½" 12.70 m/m		⅝" 15.88 m/m		¾" 19.05 m/m		⅞" 22.23 m/m		1" 25.40 m/m		1⅛" 28.58 m/m		1¼" 31.75 m/m		1⅜" 34.93 m/m	
			Approximate Weight in Pounds per Foot and Kilos per Meter															
			lbs.	kilos	lbs.	kilos	lbs.	kilos	lbs.	kilos	lbs.	kilos	lbs.	kilos	lbs.	kilos	lbs.	kilos
20	.035	0.89	.22	.33	.28	.42	.34	.51	.40	.60	.46	.68	.52	.77	....	....	....	....
18	.049	1.24	.30	.45	.38	.57	.47	.70	.55	.82	.63	.94	.72	1.07	....	....	....	....
16	.065	1.65	.38	.57	.49	.73	.60	.89	.72	1.07	.83	1.24	.94	1.40	1.05	1.56	1.16	1.73
14	.083	2.11	....	....	....	....	.75	1.12	.89	1.32	1.03	1.53	1.17	1.74	1.32	1.96	1.46	2.17
13	.095	2.41	....	....	....	....	....	....	1.01	1.50	1.17	1.74	1.33	1.98	1.49	2.22	1.65	2.46
12	.109	2.77	....	....	....	....	....	....	....	....	1.32	1.96	1.50	2.23	1.69	2.51	1.87	2.78
11	.120	3.05	....	....	....	....	....	....	....	....	1.43	2.13	1.64	2.44	1.84	2.74	2.05	3.05

SHELBY" COLD DRAWN SEAMLESS STEEL SQUARE TUBING.—*Continued*

Thickness			Size (Outside Measurement) in Inches and Millimeters											
	Dec. of an Inch	m/m	1½″ 38.10 m/m		1¾″ 44.45 m/m		2″ 50.80 m/m		2¼″ 57.15 m/m		2½″ 63.50 m/m		2¾″ 69.85 m/m	
			Approximate Weight in Pounds per Foot and Kilos per Meter											
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
6	.065	1.65	1.27	1.89	1.49	2.22	1.71	2.54	....	....	....	....	....	....
4	.083	2.11	1.60	2.38	1.88	2.80	2.16	3.21	....	....	....	....	....	....
3	.095	2.41	1.81	2.69	2.14	3.18	2.46	3.66	2.78	4.14	3.10	4.61	3.43	5.10
2	.109	2.77	2.06	3.07	2.43	3.62	2.80	4.17	3.17	4.72	3.54	5.27	3.91	5.82
1	.120	3.05	2.25	3.35	2.66	3.96	3.06	4.55	3.47	5.16	3.88	5.77	4.29	6.38
0	.134	3.40	....	....	2.94	4.38	3.40	5.06	3.85	5.73	4.31	6.41	4.76	7.08
n.														
5/32	.156	3.97	....	....	3.38	5.03	3.91	5.82	4.44	6.61	4.97	7.40	5.50	8.18
3/16	.188	4.76	....	....	3.98	5.92	4.62	6.88	5.25	7.81	5.89	8.77	6.53	9.72
¼	.250	6.35	....	....	....	....	....	....	6.65	9.90	7.48	11.13	8.31	12.37

Thickness			Size (Outside Measurement) in Inches and Millimeters									
B W G	Dec. of an Inch	m/m	3″ 76.20 m/m		3¼″ 82.55 m/m		3½″ 88.90 m/m		3¾″ 95.25 m/m		4″ 101.60 m/m	
			Approximate Weight in Pounds per Foot and Kilos per Meter									
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
13	.095	2.41	3.75	5.58	4.07	6.06	.....	.....	.....	.....	.....	.....
12	.109	2.77	4.28	6.37	4.65	6.92	.....	.....	.....	.....	.....	.....
11	.120	3.05	4.69	6.98	5.10	7.59	.....	.....	.....	.....	.....	.....
10	.134	3.40	5.22	7.77	5.67	8.44	6.13	9.12	6.58	9.79	7.04	10.48
In.												
5/32	.156	3.97	6.04	8.99	6.57	9.78	7.10	10.57	7.63	11.35	8.16	12.14
3/16	.188	4.76	7.16	10.66	7.80	11.61	8.44	12.56	9.07	13.50	9.71	14.45
¼	.250	6.35	9.14	13.60	10.19	15.17	11.04	16.43	11.89	17.69	12.74	18.96
5/16	.313	7.94	....	.....	.....	.....	13.53	20.14	14.60	21.73	15.65	23.29
⅜	.375	9.53	....	.....	.....	.....	15.92	23.69	17.19	25.58	18.47	27.49

"SHELBY" COLD DRAWN SEAMLESS STEEL RECTANGULAR TUBING

To ascertain the weight for Rectangular Tubing, add the dimensions of the four sides together, divide by four, and use the corresponding size in the above tables of Square Tubing.

"SHELBY" HOT ROLLED SEAMLESS STEEL ROUND TUBING

Thickness			Outside Diameter in Inches and Millimeters								
B W G	Dec. of an Inch	m/m	2" 50.80 m/m		2¼" 57.15 m/m		2½" 63.50 m/m		2¾" 69.85 m/m		76.2
			Approximate Weights in Pounds per Foot and Kilos per M								
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.
11	.120	3.05	2.41	3.59	2.73	4.06	3.05	4.54	3.37	5.01	3.69
10	.134	3.40	2.67	3.97	3.03	4.51	3.39	5.05	3.74	5.57	4.10
In.											
5/32	.156	3.97	3.07	4.57	3.49	5.19	3.91	5.82	4.32	6.43	4.74
3/16	.188	4.76	3.63	5.40	4.13	6.15	4.63	6.89	5.13	7.63	5.63
7/32	.219	5.56	4.16	6.19	4.74	7.05	5.32	7.92	5.91	8.79	6.49
¼	.250	6.35	4.67	6.95	5.33	7.93	6.00	8.93	6.67	9.92	7.33
5/16	.313	7.94	5.63	8.38	6.46	9.61	7.29	10.85	8.13	12.10	8.96
⅜	.375	9.53	....	....	....	....	....	....	9.51	14.15	10.50
7/16	.438	11.11	....	....	....	....	....	....	10.79	16.06	11.96

Thickness			Outside Diameter in Inches and Millimeters										
B W G	Dec. of an Inch	m/m	3¼" 82.55 m/m		3½" 88.90 m/m		3¾" 95.25 m/m		4" 101.60 m/m		4¼" 107.95 m/m		114.
			Approximate Weights in Pounds per Foot and Kilos per M										
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lb
11	.120	3.05	4.01	5.97	4.33	6.44	....	....	....	....	....	....	...
10	.134	3.40	4.45	6.62	4.82	7.17	5.18	7.71	5.53	8.23	....	....	...
In.													
5/32	.156	3.97	5.16	7.68	5.57	8.29	5.99	8.91	6.41	9.54	....	....	...
3/16	.188	4.76	6.13	9.12	6.63	9.87	7.13	10.61	7.63	11.35	8.13	12.10	8.
7/32	.219	5.56	7.07	10.52	7.66	11.40	8.24	12.26	8.82	13.13	9.41	14.00	9.
¼	.250	6.35	8.00	11.90	8.67	12.90	9.34	13.90	10.00	14.88	10.67	15.88	11.
5/16	.313	7.94	9.79	14.57	10.63	15.82	11.46	17.05	12.29	18.29	13.13	19.54	13.
⅜	.375	9.53	11.50	17.11	12.50	18.60	13.50	20.09	14.50	21.58	15.50	23.07	16.
7/16	.438	11.11	13.13	19.54	14.29	21.27	15.46	23.01	16.63	24.75	17.79	26.47	18.
½	.500	12.70	14.67	21.83	16.00	23.81	17.34	25.80	18.67	27.78	20.00	29.76	21.
9/16	.562	14.29	16.13	24.00	17.63	26.24	19.13	28.47	20.63	30.70	22.13	32.93	23.
⅝	.625	15.88	17.50	26.04	19.17	28.53	20.84	31.01	22.50	33.48	24.17	35.97	25.
¾	.750	19.05	....	....	....	....	24.01	35.73	26.00	38.69	28.01	41.68	30.
⅞	.875	22.23	....	....	....	....	26.84	39.94	29.17	43.41	31.51	46.89	33.
1"	1.000	25.40	....	....	....	....	....	....	32.01	47.64	34.67	51.60	37.

"SHELBY" HOT ROLLED SEAMLESS STEEL ROUND TUBING.—*Continued*

Thickness			Outside Diameter in Inches and Millimeters											
	Dec. of an Inch	m/m	4¾" 120.65 m/m		5" 127.00 m/m		5¼" 133.35 m/m		5½" 139.70 m/m		5¾" 146.05 m/m		6" 152.40 m/m	
			Approximate Weights in Pounds per Foot and Kilos per Meter											
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
3/16	.188	4.76	9.13	13.59	9.63	14.33	....	....	....	....	....	....	....	....
7/32	.219	5.56	10.58	15.74	11.16	16.61	11.74	17.47	12.32	18.33	12.94	19.26	13.52	20.12
¼	.250	6.35	12.00	17.86	12.67	18.86	13.34	19.85	14.00	20.83	14.69	21.86	15.35	22.84
5/16	.313	7.94	14.79	22.01	15.63	23.26	16.46	24.49	17.30	25.74	18.15	27.01	18.98	28.24
⅜	.375	9.53	17.51	26.06	18.51	27.55	19.51	29.03	20.51	30.52	21.53	32.04	22.53	33.53
7/16	.438	11.11	20.13	29.96	21.30	31.70	22.46	33.42	23.63	35.17	24.82	36.93	25.99	38.68
½	.500	12.70	22.67	33.73	24.00	35.72	25.34	37.71	26.67	39.69	28.04	41.73	29.37	43.71
9/16	.562	14.29	25.13	37.40	26.63	39.63	28.13	41.86	29.63	44.10	31.16	46.37	32.67	48.62
⅝	.625	15.88	27.51	40.94	29.17	43.41	30.84	45.89	32.51	48.38	34.21	50.91	35.88	53.40
¾	.750	19.05	32.01	47.63	34.01	50.61	36.01	53.59	38.01	56.36	40.05	59.60	42.05	62.58
⅞	.875	22.23	36.18	53.84	38.51	57.31	40.84	60.77	43.17	64.25	45.56	67.80	47.89	71.27
	1.000	25.40	40.01	59.54	42.68	63.52	45.34	67.47	48.01	71.44	50.73	75.50	53.40	79.47
1⅛	1.125	28.57	....	....	....	....	....	....	....	....	55.57	82.70	58.57	87.16

Thickness			Outside Diameter in Inches and Millimeters											
	Dec. of an Inch	m/m	6¼" 158.75 m/m		6½" 165.10 m/m		6¾" 171.45 m/m		7" 177.80 m/m		7¼" 184.15 m/m		7½" 190.50 m/m	
			Approximate Weights in Pounds per Foot and Kilos per Meter											
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
7/32	.219	5.56	14.11	21.00	14.69	21.86	15.28	22.74	15.86	23.60	16.45	24.48	17.03	25.34
¼	.250	6.35	16.02	23.84	16.69	24.84	17.36	25.83	18.02	26.82	18.69	27.81	19.36	28.81
5/16	.313	7.94	19.82	29.49	20.65	30.73	21.49	31.98	22.32	33.21	23.15	34.45	23.99	35.70
⅜	.375	9.53	23.53	35.02	24.53	36.50	25.53	37.99	26.53	39.48	27.53	40.97	28.54	42.47
7/16	.438	11.11	27.16	40.42	28.33	42.16	29.50	43.90	30.66	45.63	31.83	47.37	33.00	49.11
½	.500	12.70	30.71	45.70	32.04	47.68	33.38	49.67	34.71	51.65	36.05	53.65	37.38	55.62
9/16	.562	14.29	34.17	50.85	35.67	53.08	37.17	55.32	38.67	57.55	40.18	59.80	41.68	62.03
⅝	.625	15.88	37.55	55.88	39.22	58.37	40.88	60.84	42.55	63.32	44.22	65.81	45.89	68.29
¾	.750	19.05	44.06	67.57	46.06	68.55	48.06	71.52	50.06	74.50	52.07	77.49	54.07	80.47
⅞	.875	22.23	50.23	74.75	52.57	78.23	54.90	81.70	57.24	85.18	59.58	88.67	61.91	92.13
1	1.000	25.40	56.07	83.44	58.74	87.42	61.41	91.39	64.08	95.36	66.75	99.34	69.42	103.31
1⅛	1.125	28.57	61.58	91.64	64.58	96.11	67.59	100.59	70.59	105.05	73.59	109.52	76.60	114.00

"SHELBY" HOT ROLLED SEAMLESS STEEL ROUND TUBING.—*Continu*

Thickness			Outside Diameter in Inches and Millimeters										
B W G	Dec. of an Inch	m/m	7¾" 196.85 m/m		8" 203.20 m/m		8¼" 209.55 m/m		8½" 215.90 m/m		8¾" 222.25 m/m		228
			Approximate Weights in Pounds per Foot and Kilos per Mete										
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lb
In.													
7/32	.219	5.56	17.62	26.22	18.20	27.08	18.78	27.95	19.37	28.82	19.95	29.69	20.
¼	.250	6.35	20.03	29.81	20.69	30.79	21.36	31.79	22.03	32.78	22.70	33.78	23.
5/16	.313	7.94	24.82	36.93	25.66	38.18	26.49	39.42	27.33	40.67	28.16	41.90	28.
⅜	.375	9.53	29.54	43.96	30.54	45.45	31.54	46.93	32.54	48.42	33.54	49.91	34.
7/16	.438	11.11	34.17	50.85	35.34	52.59	36.50	54.32	37.67	56.05	38.84	57.80	40.
½	.500	12.70	38.72	57.62	40.05	59.60	41.39	61.59	42.72	63.57	44.06	65.56	45.
9/16	.562	14.29	43.18	64.26	44.68	66.49	46.18	68.72	47.69	70.97	49.19	73.20	50.
⅝	.625	15.88	47.56	70.78	49.23	73.26	50.90	75.55	52.57	78.23	54.24	80.72	55.
¾	.750	19.05	56.07	83.44	58.07	86.42	60.08	89.41	62.08	92.39	64.08	95.36	66.
⅞	.875	22.23	64.25	95.62	66.58	99.08	68.92	102.57	71.26	106.05	73.59	109.52	75.
1	1.000	25.40	72.09	107.28	74.76	111.26	77.43	115.23	80.10	119.20	82.77	123.18	85.
1⅛	1.125	28.57	79.60	118.46	82.60	122.92	85.61	127.40	88.61	131.87	91.62	136.35	94.

"SHELBY" HOT DRAWN SEAMLESS STEEL ROUND TUBING

Thickness		Outside Diameter in Inches and Millimeters											
		6" 152.40 m/m		6½" 165.10 m/m		7" 177.80 m/m		7½" 190.50 m/m		8" 203.20 m/m		8½" 215.90 m/m	
Dec. of an Inch	m/m	Approximate Weight in Pounds per Foot and Kilos per Meter											
		Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
.250	6.35	15.35	22.84	16.69	24.84	18.02	26.82	19.36	28.81	20.69	30.79	22.03	32.78
.312	7.94	18.98	28.25	20.65	30.73	22.32	33.22	23.99	35.70	25.66	38.19	27.33	40.67
.375	9.52	22.53	33.53	24.53	36.50	26.53	39.48	28.54	42.47	30.54	45.45	32.54	48.43
.500	12.70	29.37	43.71	32.04	47.68	34.71	51.65	37.38	55.63	40.05	59.60	42.72	63.57
.625	15.88	35.88	53.40	39.22	58.37	42.55	63.32	45.89	68.29	49.23	73.26	52.57	78.23
.750	19.05	42.05	62.57	46.06	68.54	50.06	74.50	54.07	80.46	58.07	86.42	62.08	92.38
.875	22.23	47.89	71.27	52.57	78.23	57.24	85.18	61.91	92.13	66.58	99.08	71.26	106.0
1.000	25.40	53.40	79.46	58.74	87.41	64.08	95.36	69.42	103.3	74.76	111.3	80.10	119.2
1.125	28.58	58.57	87.16	64.58	96.10	70.59	105.1	76.60	114.0	82.60	122.9	88.61	131.9
1.250	31.75	63.41	94.37	70.09	104.31	76.76	114.2	83.44	124.2	90.11	134.1	96.79	144.0
1.375	34.93	67.92	101.08	75.26	112.00	82.60	122.9	89.95	133.9	97.29	144.8	104.63	155.7
1.500	38.10	72.09	107.28	80.10	119.20	88.11	131.1	96.12	143.0	104.13	155.0	112.14	166.9

Thickness			Outside Diameter in Inches and Millimeters									
			9" 228.6 m/m		9½" 241.3 m/m		10" 254.0 m/m		10½" 266.7 m/m		11" 279.4 m/m	
Inches	Dec. of an Inch	m/m	Approximate Weight in Pounds per Foot and Kilos per Meter									
			Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
¼	.250	6.35	23.36	34.76	24.70	36.76	26.03	38.74	27.37	40.73	28.70	42.71
5/16	.312	7.94	28.99	43.14	30.66	45.63	32.33	48.11	34.00	50.60	35.67	53.08
⅜	.375	9.52	34.54	51.40	36.55	54.39	38.55	57.37	40.55	60.34	42.55	63.32
½	.500	12.70	45.39	67.54	48.06	71.52	50.73	75.49	53.40	79.46	56.07	83.44
⅝	.625	15.88	55.90	83.18	59.24	88.16	62.58	93.12	65.92	98.10	69.25	103.1
¾	.750	19.05	66.08	98.33	70.09	104.3	74.09	110.3	78.10	116.2	82.10	122.2
⅞	.875	22.23	75.93	113.0	80.60	119.9	85.27	126.9	89.95	133.9	94.62	140.8
1	1.000	25.40	85.44	127.1	90.78	135.1	96.12	143.0	101.46	151.0	106.80	158.9
1⅛	1.125	28.58	94.62	140.8	100.63	149.8	106.63	158.7	112.64	167.6	118.65	176.6
1¼	1.250	31.75	103.46	154.0	110.14	163.9	116.81	173.8	123.49	183.8	130.16	193.7
1⅜	1.375	34.93	111.97	166.6	119.32	177.6	126.66	188.5	134.00	199.4	141.35	210.4
1½	1.500	38.10	120.15	178.8	128.16	190.7	136.17	202.6	144.18	214.5	152.19	226.5

"SHELBY" HOT DRAWN SEAMLESS STEEL ROUND TUBING.—*Contin*

Thickness			Outside Diameter in Inches and Millimeters								
			11½" 292.1 m/m		12" 304.8 m/m		13" 330.2 m/m		14" 355.6 m/m		381
			Approximate Weight in Pounds per Foot and Kilos per M								
Inches	Dec. of an Inch	m/m	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs
$\frac{1}{4}$	.250	6.35	30.04	44.70	31.37	46.68	34.04	50.66	36.71	54.61	39.
$\frac{5}{16}$	.312	7.94	37.34	55.53	39.01	58.05	42.35	63.02	45.68	67.98	49.
$\frac{3}{8}$	.375	9.52	44.56	66.31	46.56	69.29	50.56	75.24	54.57	81.20	58.
$\frac{1}{2}$	.500	12.70	58.74	87.41	61.41	91.38	66.75	99.32	72.09	107.3	77.
$\frac{5}{8}$	.625	15.88	72.59	108.0	75.93	113.0	82.60	122.9	89.28	132.9	95.
$\frac{3}{4}$	.750	19.05	86.11	128.1	90.11	134.1	98.12	146.0	106.13	157.9	114.
$\frac{7}{8}$	.875	22.23	99.29	147.8	103.96	154.7	113.31	168.6	122.65	182.5	132.
1	1.000	25.40	112.14	166.9	117.48	174.8	128.16	190.7	138.84	206.6	149.
$1\frac{1}{8}$	1.125	28.58	124.66	185.5	130.67	194.5	142.68	212.3	154.70	230.2	166.
$1\frac{1}{4}$	1.250	31.75	136.84	203.6	143.51	213.6	156.86	233.4	170.22	253.3	183.
$1\frac{3}{8}$	1.375	34.93	148.69	221.3	156.03	232.2	170.72	254.1	185.40	275.9	200.
$1\frac{1}{2}$	1.500	38.10	160.20	238.4	168.21	250.3	184.23	274.2	200.25	298.0	216.

Thickness			Outside Diameter in Inches and Millimeters								
			16" 406.4 m/m		17" 431.8 m/m		18" 457.2 m/m		19" 482.6 m/m		508
			Approximate Weight in Pounds per Foot and Kilos per M								
Inches	Dec. of an Inch	m/m	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs
$\frac{1}{4}$	.250	6.35	42.05	62.57	44.72	66.55	47.39	70.52	50.06	74.50	52.
$\frac{5}{16}$	.312	7.94	52.36	77.91	55.70	82.88	59.03	87.84	62.37	92.81	65.
$\frac{3}{8}$	.375	9.52	62.58	93.12	66.58	99.07	70.59	105.0	74.59	111.0	78.
$\frac{1}{2}$	.500	12.70	82.77	123.2	88.11	131.1	93.45	139.1	98.79	147.0	104.
$\frac{5}{8}$	.625	15.88	102.63	152.7	109.30	162.6	115.98	172.6	122.65	182.5	129.
$\frac{3}{4}$	.750	19.05	122.15	181.8	130.16	193.7	138.17	205.6	146.18	217.5	154.
$\frac{7}{8}$	.875	22.23	141.35	210.3	150.69	224.2	160.04	238.2	169.38	252.0	178.
1	1.000	25.40	160.20	238.4	170.88	254.3	181.56	270.2	192.24	286.1	202.
$1\frac{1}{8}$	1.125	28.58	178.73	266.0	190.74	283.8	202.76	301.7	214.77	319.6	226.
$1\frac{1}{4}$	1.250	31.75	196.92	293.0	210.27	312.9	223.62	332.8	236.97	352.6	250.
$1\frac{3}{8}$	1.375	34.93	214.77	319.6	229.46	341.4	244.14	363.3	258.83	385.2	273.
$1\frac{1}{2}$	1.500	38.10	232.29	345.7	248.31	369.5	264.33	393.3	280.35	417.2	296.

SEAMLESS STEEL CYLINDERS

SEAMLESS STEEL CYLINDERS FOR THE SHIPMENT OF CARBONIC ACID GAS, NITROUS OXIDE GAS, BLAUGAS, AND ANY LIQUEFIED GAS WHOSE CHARGING PRESSURE AT 70° F. (21.1° C.) EXCEEDS 300 POUNDS PER SQUARE INCH (21.09 KILOS PER SQ. CM.)

NATIONAL TUBE COMPANY
REVISED SHIPPING CONTAINER SPECIFICATION NO. 3
MARCH 15, 1919

(Clauses 1 to 17 [inclusive] of this specification are copied from the Interstate Commerce Commission's Regulations for the Transportation of Explosives and other Dangerous Articles by freight and Express and Specifications for Shipping Containers, effective October 1st, 1914.)

1. Cylinders purchased hereafter and used for the shipment of carbonic acid gas, nitrous oxide gas, blaugas, or any liquefied gas whose charging pressure at 70° F. exceeds 300 pounds per square inch must comply with the following specifications. Such cylinders purchased between March 31, 1912, and the effective date of these specifications must comply with the specifications effective March 31, 1912, or with these specifications.

2. Cylinders must be made seamless, of steel of uniform quality.

Chemical Analysis

3. CARBON must not exceed....... 0.55 Per Cent.
PHOSPHORUS must not exceed. . 0.04 Per Cent.
SULPHUR must not exceed...... 0.05 Per Cent.

Annealing

4. All cylinders after finishing must be uniformly and properly annealed. All dirt and scale must be removed from both inside and outside of the cylinders.

Flattening Test

5. From each lot of 200 or less a representative finished cylinder, after annealing and after having passed the hydrostatic test, must be selected at random and must withstand, without cracking, flattening between rounded knife-edges to a thickness of six times the thickness of the wall of the cylinder, this measurement to be made between the outside surfaces of the walls of the cylinder.

The knife edges must be of wedge shape, converging at an angle of 60°, the point being rounded off with a radius of ½ inch. If any one cylinder from any lot fails to pass this test, two others from the same lot must be selected, and these must pass it in order to have the lot accepted.

SEAMLESS STEEL CYLINDERS.—*Continued*

N. T. CO. SPECIFICATION NO. 3.—*Continued*

If it should appear that failure in the test is due to impro annealing, the manufacturer has the privilege of re-anneal the lot and repeating the test.

Physical Tests

6. One out of each lot of two hundred or less finished c inders after annealing must be selected at random and te made on test specimens cut longitudinally therefrom to det mine the elastic limit, the tensile strength, and the elongati of the material. These test specimens should, when practi able, be taken from the same cylinders which are used for t flattening test.

The elongation must be not less than 10 per cent. on 8-inch test specimen.

The elastic limit must not be more than 70 per cent. of t tensile strength.

Hydrostatic Test

7. Each finished and annealed cylinder must be subjecte to a hydrostatic test of not less than 3,000 pounds per squa inch in a water jacket, or other apparatus of suitable form, t furnish reliable data. The permanent volumetric expansio must not exceed 10 per cent of the whole volumetric expansio at this pressure.

This test must be made without subjecting the cylinder to any previous internal pressure in excess of 1,000 pounds.

In the hydrostatic test the water gauge indicating the expansion must be of such interior diameter that the total expansion will cause the water to rise at least 45 centimeters in the gauge, except when this will make the interior diameter less than 4 millimeters; the pressure must be applied for not less than 30 seconds and as much longer as may be necessary to insure complete expansion of the cylinder. The expansion must be recorded in terms of cubic centimeters.

Marking

8. Each cylinder must be plainly and permanently marked on the shoulder with a serial number and with the name or initials of the original purchaser.

9. Each cylinder must also be plainly and permanently marked on the shoulder with the words "COMPLIES WITH I. C. C. SPEC'N ·No. 3"; or, if desired by the purchaser, this may be abbreviated to "I. C. C.-3." This marking must be

SEAMLESS STEEL CYLINDERS.—*Continued*

N. T. Co. SPECIFICATION No. 3.—*Continued*

immediately above the serial number and in letters not n ¼ inch high.

he date of the hydrostatic test must also be stamped on nder (for example, 4-09 for April, 1909) in such manner e dates of subsequent quinquennial tests required by ph 1861 (i) may be easily added thereto.

General Construction

ll billets, plates, or tubes from which cylinders are nust be free from seams, cracks, laminations or any dehich might be injurious to the finished cylinder.

The manufacture of the cylinders must be completed he best appliances and according to the best modern ds. All finished cylinders must show reasonably smooth iiform surface finish, inspection of inside surface to be before necking down; the threading of the cylinder neck e even and without checks, and the cylinders must show ects of workmanship or material likely to result in any iable weakness of the finished cylinder. A close inon of each completed cylinder must be made before tance to discover any defect.

Inspection

The purchaser must provide for inspection of all maand all tests by a competent and disinterested inspector.

The inspector must keep complete records of the various from which the steel is taken for the manufacture of ylinders. Certified chemical analyses of these melts be supplied to him by the manufacturer, or, if desired by urchaser, he must procure samples from each melt from other chemical analyses may be made. The heat er must be stamped on the plates and billets at the steel and the inspector must also stamp his initials or personal on each plate or billet accepted by him, and no plate or must be used for the manufacture of cylinders unless so ed.

ovided, that when cylinders are to be made from drawn less tubing under such conditions that the various heats of l can not be properly traced through to the finished cylin-

SEAMLESS STEEL CYLINDERS.—*Continued*

N. T. CO. SPECIFICATION NO. 3.—*Continued*

ders, a certificate from the manufacturer of the tubi
gether with check analyses of samples taken from one
each lot of 200 or less finished cylinders, shall be accepte

15. The inspector shall make such inspection as n
necessary to see that the requirements of paragraphs 11
are complied with, shall see that the finished cylind
properly annealed, and shall witness all hydrostatic a
tening tests.

The hydrostatic and flattening tests must be made
manufacturer, but under the direction and supervision
inspector or other representative of the purchaser.

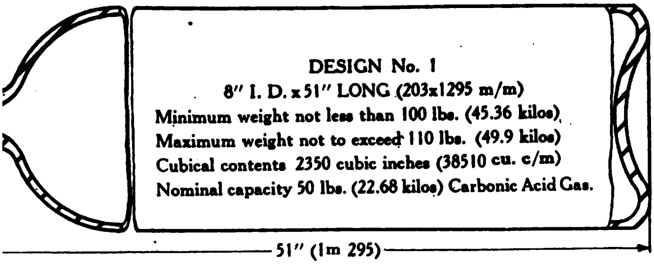
16. The inspector shall stamp his initials or his p
sign immediately beneath the serial number on each c
which he passes as accepted and shall make a certified
to the maker, to the purchaser, and to the chief ins
Bureau of Explosives, 30 Vesey Street, New York City,
ing the serial numbers of all cylinders which are acc
together with a copy of all data relating to the materi
the tests.

17. The purchasers of cylinders may impose addition
quirements not inconsistent with these specifications.

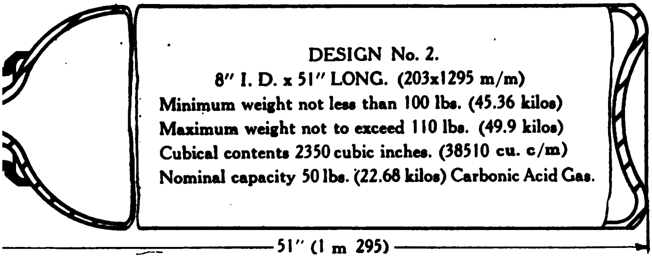
SEAMLESS STEEL CYLINDERS.—*Continued*

STANDARD DESIGNS OF CARBONIC ACID GAS CYLINDERS

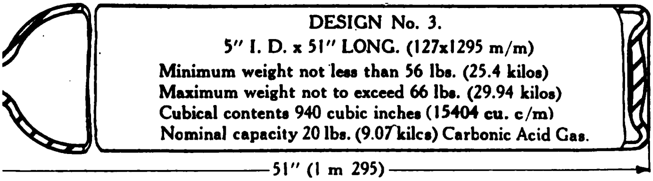
pressure—1800 lbs. per square inch (126.5 kilos per sq. c/m).
ders tested to 3000 lbs. per square inch (210.9 kilos per sq. c/m).
ders tapped to suit customer's valve.



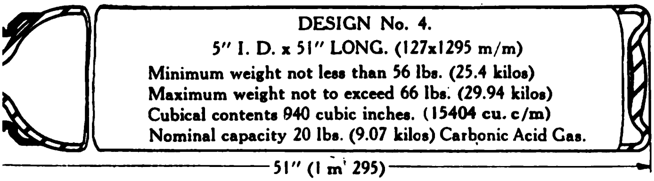
DESIGN No. 1
8" I. D. x 51" LONG (203x1295 m/m)
Minimum weight not less than 100 lbs. (45.36 kilos)
Maximum weight not to exceed 110 lbs. (49.9 kilos)
Cubical contents 2350 cubic inches (38510 cu. c/m)
Nominal capacity 50 lbs. (22.68 kilos) Carbonic Acid Gas.



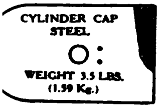
DESIGN No. 2.
8" I. D. x 51" LONG. (203x1295 m/m)
Minimum weight not less than 100 lbs. (45.36 kilos)
Maximum weight not to exceed 110 lbs. (49.9 kilos)
Cubical contents 2350 cubic inches. (38510 cu. c/m)
Nominal capacity 50 lbs. (22.68 kilos) Carbonic Acid Gas.



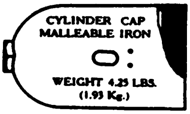
DESIGN No. 3.
5" I. D. x 51" LONG. (127x1295 m/m)
Minimum weight not less than 56 lbs. (25.4 kilos)
Maximum weight not to exceed 66 lbs. (29.94 kilos)
Cubical contents 940 cubic inches (15404 cu. c/m)
Nominal capacity 20 lbs. (9.07 kilos) Carbonic Acid Gas.



DESIGN No. 4.
5" I. D. x 51" LONG. (127x1295 m/m)
Minimum weight not less than 56 lbs. (25.4 kilos)
Maximum weight not to exceed 66 lbs. (29.94 kilos)
Cubical contents 940 cubic inches. (15404 cu. c/m)
Nominal capacity 20 lbs. (9.07 kilos) Carbonic Acid Gas.



) O.D. x No. 10 B. W. G.
178 m/m) long



4¼" (108 m/m) O.D. x
7" (178 m/m) long

SEAMLESS STEEL CYLINDERS.—*Continued*

STEEL CYLINDERS FOR THE SHIPMENT OF NON-LIQUEFIED GASES WHOSE CHARGING PRESSURES AT 70° F. (21.1° C.) EXCEED 300 POUNDS PER SQUARE INCH (21.09 KILOS PER SQ. CM.)

NATIONAL TUBE COMPANY
REVISED SHIPPING CONTAINER SPECIFICATION NO. 3-A
MARCH 15, 1919

(Clauses 1 to 17 [inclusive] of this specification are copied from the Interstate Comm Commission's Regulations for the Transportation of Explosives and Other Dangerous Arti by Freight and Express, and Specifications for Shipping Containers, effective October 1st, 19

1. Cylinders purchased hereafter and used for the shipm of non-liquefied gases whose charging pressures at 70° exceed 300 pounds per square inch must comply with the f lowing specifications. Such cylinders purchased betw March 31, 1912, and the effective date of these specificati must comply with the specifications effective March 31, 191 or with these specifications.

2. Cylinders must be made seamless, of steel of unifor quality.

Chemical Analysis

3. CARBON must not exceed........0.55 per cent.
PHOSPHORUS must not exceed....0.04 per cent.
SULPHUR must not exceed.......0.05 per cent.

Annealing

4. All cylinders after finishing must be uniformly a properly annealed. All dirt and scale must be removed fro both inside and outside of the cylinders.

Flattening Test

5. From each lot of 200 or less a representative finished cylinder, after annealing and after having passed the hydrostatic test, must be selected at random and must withstand without cracking, flattening between rounded knife-edges to a thickness of six times the thickness of the wall of the cylinder, this measurement to be made between the outside surfaces of the walls of the cylinder.

The knife-edges must be of wedge shape, converging at an angle of 60°, the point being rounded off with a radius of ½ inch. If any one cylinder from any lot fails to pass this test, SEAMLESS STEEL CYLINDERS.—*Continued*

N. T. Co. SPECIFICATION No. 3-A.—*Continued*

to others from the same lot must be selected, and these must pass it in order to have the lot accepted.

If it should appear that failure in the test is due to improper annealing, the manufacturer has the privilege of reannealing the lot and repeating the test.

Physical Test

6. One out of each lot of two hundred or less finished cylinders after annealing must be selected at random and tests made test specimens cut longitudinally therefrom to determine the elastic limit, the tensile strength, and the elongation of the material. These test specimens should, when practicable, be taken from the same cylinders which are used for the flattening test.

The elongation must be not less than 10 per cent. on an inch test specimen.

The elastic limit must not be more than 70 per cent. of the tensile strength.

Hydrostatic Test

7. Each finished and annealed cylinder must be subjected to a hydrostatic test in a water jacket, or other apparatus of suitable form, to furnish reliable data. The test pressure must not be less than 1⅔ times the charging pressure corresponding to a temperature of 70° F. for which the cylinder is designed, except that the minimum allowable test pressure shall be 600 pounds per square inch. The permanent volumetric expansion must not exceed 10 per cent. of the whole volumetric expansion at this pressure.

This test must be made without subjecting the cylinder to any previous internal pressure in excess of one-third of the test pressure.

In the hydrostatic test the water gauge indicating the expansion must be of such interior diameter that the total expansion will cause the water to rise at least 45 centimeters in the gauge, except when this will make the interior diameter less than 4 millimeters; the pressure must be applied for not less than 30 seconds and as much longer as may be necessary to insure complete expansion of the cylinder. The expansion must be recorded in terms of cubic centimeters.

SEAMLESS STEEL CYLINDERS.—*Continued*

N. T. Co. SPECIFICATION No. 3-A.—*Continued*

Marking

8. Each cylinder must be plainly and permanently marked on the shoulder with a serial number and with the name o initials of the original purchaser.

9. Each cylinder must also be plainly and permanently marked with the words "COMPLIES WITH I. C. C SPEC'N No. 3A***," or, if desired by the purchaser, this may be abbreviated to "I. C. C.-3A***." The stars to be replaced by figures indicating the charging pressure for which the cylinder is designed which will be not more than three-fifths of the pressure used in the test prescribed by paragraph 7. This marking must be placed immediately above the serial number and in letters not less than ¼-inch high.

10. The date of the hydrostatic test must also be stamped on the cylinder (for example, 4–09 for April, 1909) in such manner that the dates of subsequent quinquennial tests required by paragraph 1861 (i) may be easily added thereto.

General Construction

11. All billets, plates, or tubes from which cylinders are made must be free from seams, cracks, laminations, or any defects which might be injurious to the finished cylinder.

12. The manufacture of the cylinders must be completed with the best appliances and according to the best modern methods. All finished cylinders must show reasonably smooth and uniform surface finish, inspection of inside surface to be made before necking down; the threading of the cylinder neck must be even and without checks and the cylinders must show no defects of workmanship or material likely to result in any appreciable weakness of the finished cylinder. A close inspection of each completed cylinder must be made before acceptance to discover any defect.

Inspection

13. The purchaser must provide for inspection of all material and all tests by a competent and disinterested inspector.

14. The inspector must keep complete records of the various melts from which the steel is taken for the manufacture of the cylinders. Certified chemical analyses of these melts must be

Seamless Steel Cylinders.—*Continued*

N. T. Co. Specification No. 3-A.—*Continued*

supplied to him by the manufacturer, or, if desired by the purchaser, he must procure samples from each melt from which other chemical analyses may be made. The heat number must be stamped on the plates and billets at the steel mill and the inspector must also stamp his initials or personal sign on each plate or billet accepted by him, and no plate or billet must be used for the manufacture of cylinders, unless so marked, provided, that when cylinders are to be made from drawn seamless tubing under conditions such that the various heats of steel can not be properly traced through to the finished cylinders, a certificate from the manufacturer of the tubing, together with check analyses of samples taken from one out of each lot of 200 or less finished cylinders, shall be accepted.

15. The inspector shall make such inspection as may be necessary to see that the requirements of paragraphs 11 and 12 are complied with, shall see that the finished cylinders are properly annealed, and shall witness all hydrostatic and flattening tests.

The hydrostatic and flattening tests must be made by the manufacturer, but under the direction and supervision of the inspector or other representative of the purchaser.

16. The inspector shall stamp his initials or his personal sign immediately beneath the serial number on each cylinder which he passes as accepted, and shall make a certified report to the maker, to the purchaser, and to the chief inspector, Bureau of Explosives, 30 Vesey Street, New York City, showing the serial numbers of all cylinders which are accepted, together with a copy of all data relating to the material and the tests.

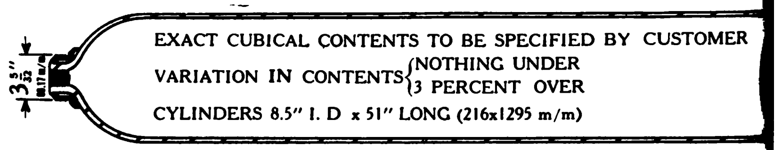
17. The purchasers of cylinders may impose additional requirements not inconsistent with these specifications.

SEAMLESS STEEL CYLINDERS.—*Continued*

STANDARD DESIGNS OF SEAMLESS STEEL OXYGEN CYLINDERS TO COMPLY WITH I. C. C. SPECIFICATIONS NO. 3-A, EFFECTIVE OCTOBER 1, 1914

NOMINAL 200 CUBIC FOOT CAPACITY OXYGEN CYLINDERS. CUBICAL CONTENTS 2640 CUBIC INCHES (43,279 cu. c/m)

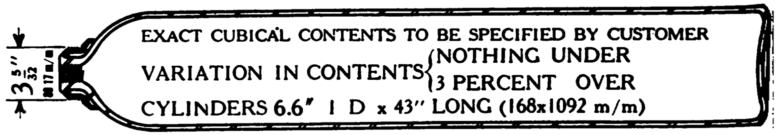
DESIGNS A AND B


3 5/32"
80.17 m/m
EXACT CUBICAL CONTENTS TO BE SPECIFIED BY CUSTOMER
VARIATION IN CONTENTS {NOTHING UNDER / 3 PERCENT OVER
CYLINDERS 8.5" I. D x 51" LONG (216x1295 m/m)

2640 Cu. In. Container	Test Pressure		Minimum Weight		Maximum Weight	
	Lbs. per Sq. In.	Kilos per c/m²	Lbs.	Kilos	Lbs.	Kilos
Design A	3360	236.21	125	56.70	135	61.23
Design B	3000	210.90	108	49.00	118	53.53

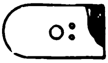
NOMINAL 100 CUBIC FOOT CAPACITY OXYGEN CYLINDERS CUBICAL CONTENTS—1335 CUBIC INCHES (21,885 cu. c/m.)

DESIGNS C AND D


3 5/32"
80.17 m/m
EXACT CUBICAL CONTENTS TO BE SPECIFIED BY CUSTOMER
VARIATION IN CONTENTS {NOTHING UNDER / 3 PERCENT OVER
CYLINDERS 6.6" I D x 43" LONG (168x1092 m/m)

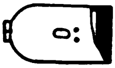
1335 Cu. In. Container	Test Pressure		Minimum Weight		Maximum Weight	
	Lbs. per Sq. In.	Kilos per c/m²	Lbs.	Kilos	Lbs.	Kilos
Design C	3360	236.21	67	30.39	77	34.93
Design D	3000	210.90	59	26.76	69	31.30

Cylinder Cap-Steel
Weight 2.5 Lbs. (1.134 Kg.)



3 5/16" (84m/m) O.D. x No. 10 B.W.G.
x 6 3/8" (162 m/m) Long

Cylinder Cap—Malleable Iron
Weight 3.25 Lbs. (1.474 Kg.)



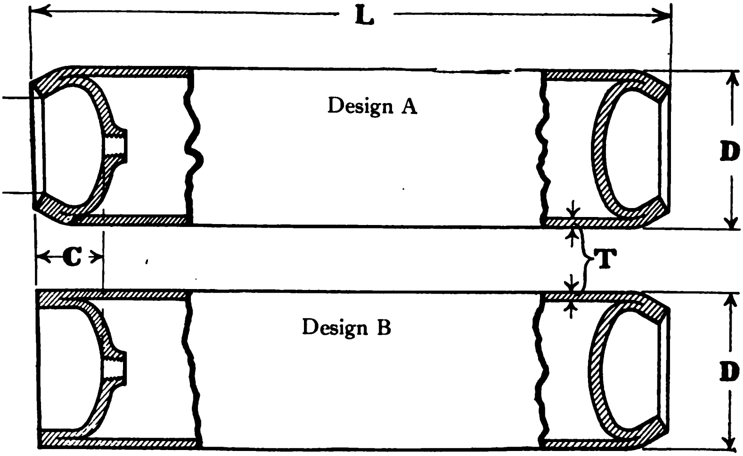
3½" (89 m/m) O.D.
x 6¾" (171 m/m) Long

All cylinders tapped to suit customer's valve

LAP-WELDED STEEL ANHYDROUS AMMONIA CYLINDERS

As Approved by The Bureau of Explosives, American Railway Association

pproved designs for Ammonia Cylinders are illustrated below, with ils as to dimensions, thickness, weight and the test pressures to be applied.



tside Diam. of linder D		Overall Length of Cylinder L		Nominal Thickness of Cylinder T		Test Pressure		"C" Depth of Head		"E" Diameter of Mouth Nominal		Weight of Cylinder			
												Low Limit		High Limit	
	m/m	Ins.	m/m	Ins.	m/m	Lbs. per sq. in.	Kilos per sq.c/m	Ins.	m/m	Ins.	m/m	Lbs.	Kilos	Lbs.	Kilos
	254	46	1168	.19	4.83	1000	70.3	3¾	95.3	7½	190.5	87	39	112	51
	254	48	1219	.19	4.83	1000	70.3	3¾	95.3	7½	190.5	90	41	115	52
	254	84	2134	.19	4.83	1000	70.3	3¾	95.3	7½	190.5	150	68	175	79
	254	46	1168	.27	6.86	1500	105.5	3¾	95.3	7½	190.5	113	51	141	64
	254	48	1219	.27	6.86	1500	105.5	3¾	95.3	7½	190.5	117	53	145	66
	254	84	2134	.27	6.86	1500	105.5	3¾	95.3	7½	190.5	203	92	237	108
	304.8	84	2134	.21	5.33	1000	70.3	3¾	95.3	9	228.6	220	100	250	113

LAP-WELDED STEEL ANHYDROUS AMMONIA CYLINDERS.—*Continued*

SPECIFICATIONS FOR LAP-WELDED STEEL ANHYDROUS AMMONIA CYLINDERS

As approved by the Bureau of Explosives,
American Railway Association

(Clauses 1 to 17 [inclusive] of this specification are copied from the Interstate Commerce Commission's Regulations for the Transportation of Explosives and other Dangerous Articles by Freight and Express and Specifications for Shipping Containers, effective October 1st, 1914.)

1. Cylinders purchased hereafter and used for the shipment of anhydrous ammonia, must comply with the following specifications.

2. Cylinders must be manufactured from lap-welded pipe, made of soft steel of the best welding quality, free from blisters, cracks or other injurious defects.

3.

Chemical Analysis	Carbon	Phosphorus	Sulphur
Must not exceed....	.20%	.11%	.05%

4. The pipe from which these cylinders are to be made must be manufactured by the best appliances and according to the best modern practice, each length after being cut into lengths for the manufacture of the cylinders to be inspected separately for defects inside and outside. Each length of pipe must be subjected to an internal hydrostatic pressure of not over 600 pounds per square inch, under which it must not show any signs of leaking.

5. Each crop end cut from the pipe from which the cylinders are to be made must be subjected to, and must withstand without cracking, flattening between rounded knife-edges to a thickness of six times the thickness of the wall of the pipe. This measurement must be made between the outside surfaces of the walls of the pipe and the test must be applied with the weld not more than 45° away from the side which is subjected to the greatest stress.

The knife-edges must be of wedge shape, converging at an angle of 60°, the point being rounded off with a radius of ½ inch. If any crop end fails to pass this test, then another ring cut from the same end of the pipe may be tested.

6. Each cylinder after finishing should be uniformly and properly annealed. This may be done after the testing prescribed in paragraph 8. Dirt and scale must be removed before painting.

7. One out of each lot of 200 or less finished cylinders after annealing must be selected at random and tests made on test specimens cut longitudinally therefrom to determine the elastic limit, the tensile strength, and elongation of the material.

The elongation must not be less than 20 per cent. on an 8-inch test specimen.

The elastic limit must not be more than 70 per cent. of the tensile strength.

Lap-Welded Steel Anhydrous Ammonia Cylinders.—*Continued*

Each finished cylinder must be subjected to a hydrostatic test pressure
t less than 1,000 pounds per square inch in a water jacket, or other appara-
f suitable form, to furnish reliable data. The permanent volumetric
nsion must not exceed 10 per cent. of the whole volumetric expansion
is pressure.
is test must be made without subjecting the cylinder to any previous
ostatic pressure; provided, however, that a preliminary pressure of not
than 80 per cent. of the prescribed test pressure may be applied once
, previous to the official test, for the purpose of rounding out the cylinder.

. In the hydrostatic test the water gauge indicating the expansion must
f such interior diameter that the total expansion will cause the water to
at least 45 centimeters in the gauge, except when this will make the interior
neter less than 4 millimeters; the pressure must be applied for not less than
econds and as much longer as may be necessary to insure complete expan-
of the cylinder. The expansion must be recorded in terms of cubic
timeters.

0. Each cylinder must be plainly and permanently marked with the name
nitials of the owner or owning company.

1. Each cylinder must also be plainly and permanently marked on the
d with a serial number and with the words "COMPLIES WITH I. C. C.
EC'N No. 4" or, if desired by the purchaser, this may be abbreviated to
C. C.-4." This marking must be placed immediately above the serial
mber and in letters not less than ¼ inch high.
The date of the hydrostatic test must also be plainly stamped on the head
the cylinder. (For example, 4-09 for April, 1909.)

12. When offered for shipment the package must also bear such other de-
iption as may be required by the I. C. C. Regulations for the particular
ticle contained therein.

13. The manufacture of the cylinders must be completed with the best
pliances and according to the best modern methods. All finished cylinders
ust show reasonably smooth and uniform surface finish, inspection of inside
rface being made before putting in the heads and bottoms; the threading of
lve seat must be even and without checks and the cylinders must show no
fects of workmanship or material likely to result in any appreciable weak-
ss of the finished cylinder. A close inspection of each completed cylinder
ust be made before acceptance to discover any defects.

14. The purchaser must provide for inspection of all material and all tests
a competent and disinterested inspector.

Lap-Welded Steel Anhydrous Ammonia Cylinders.—*Continued*

15. The inspector shall make such inspection as may be necessary to that the requirements of paragraphs 4 and 13 are complied with, shall n the minimum thickness of wall of the pipe used, and shall witness all the hyd static tests.

16. The inspector shall obtain from the manufacturer of the cylinde certificate signed by the manufacturer of the steel from which the cylind are made and submit it with his report.

17. The inspector shall stamp his initials or his personal sign immediat beneath the serial number of each cylinder which he passes as accepted shall make a certified report to the maker, to the purchaser, and to the C Inspector, Bureau of Explosives, 30 Vesey Street, New York City, showing t serial numbers of all cylinders which are accepted together with a copy of data relating to the material and the tests.

18. The purchaser of cylinders may impose additional requirements n inconsistent with these specifications.

"JUNIATA" HORSE AND MULE SHOES

"Juniata" Horse and Mule Shoes, manufactured at the Shoenberger Works the American Steel and Wire Company, have a well established reputation many years' standing, the founders of the Shoenberger Works having been nong the first to engage in the manufacture of Horse Shoes in America. rom time to time improvements have been made, with the result that the Juniata" brand has constantly maintained its position in the front rank, nd is today equal to the best manufactured in this or any other country. the following pages are shown the various styles manufactured, with parulars of the approximate weight of each size and the approximate number shoes in each keg of 100 lbs. (45.36 kilos) net. As indicated above the iltrations, some of the styles are made in steel only, and others in either steel iron, as may be preferred by the buyer. Steel shoes, are, however, preferred most cases, and are rapidly superseding iron shoes wherever introduced, and hey have been in use long enough to enable shoers and owners of horses to ppreciate their excellent quality.

"Juniata" Steel Shoes are made from a special quality of soft steel produced expressly for this purpose by the American Steel and Wire Company. The quality of the material is that which long experience has demonstrated to be the most suitable for making horse shoes and which will render the best service. "Juniata" Steel Shoes do not show red-shortness nor cold-shortness, neither do they split in the crease. They may be subjected to exceptionally severe tests, such as, for instance, cold twisting like a rope and cold bending double, without showing the slightest tendency to fracture. The welding qualities of "Juniata" Steel Shoes are unsurpassed. They have stood the test of being fastened in a vise and subjected to severe twisting and pulling strains, without loosening the calk. Their wearing qualities are equal to those of any other horse shoes manufactured.

"Juniata" Iron Shoes are made from the best grade of iron, specially manufactured for this purpose.

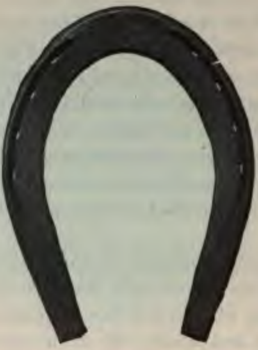
"Juniata" Shoes, whether steel or iron, are smooth and uniform, the concave correct, the creasing neat and of the proper size, the punching clean, and the holes properly spaced, so that the blacksmith can readily finish up the shoes to suit the horse's foot. The shapes are in accordance with modern ideas and have met with approval of practical horse shoers and owners wherever introduced.

If desired, the shoes can be furnished with the holes punched large enough to be used without further work by the blacksmith. The heels can also be turned up if required. Styles and shapes can be modified to suit buyers' ideas, if ordered in sufficient quantities to justify the expense.

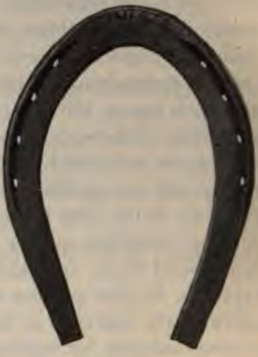
"JUNIATA" HORSE SHOES

EXTRA SWAGED PATTERN

Steel



Front



Hind

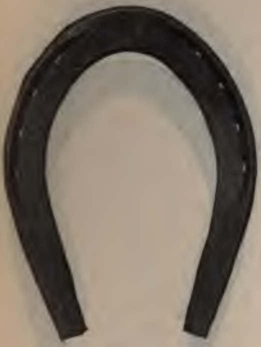
Size	Approximate Weight		Average No. of Shoes in Keg	Size	Approximate Weight		Average No. of Shoes in Keg
	Ounces	Grammes			Ounces	Grammes	
0	10	283	160	0	8	227	200
1	13	368	123	1	10	283	160
2	15½	439	103	2	12½	354	128
3	18½	524	86	3	15½	439	103
4	22	624	73	4	19	539	84
5	25½	723	63	5	22½	638	71
6	30	850	53	6	26½	751	60
7	39	1106	41	7	31	879	51

Packed in red headed, steel hooped kegs, each containing 100 pounds (45.36 kilos) net.

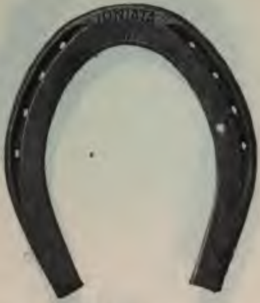
"JUNIATA" HORSE SHOES.—*Continued*

SHORT HEEL PATTERN

Steel



Front



Hind

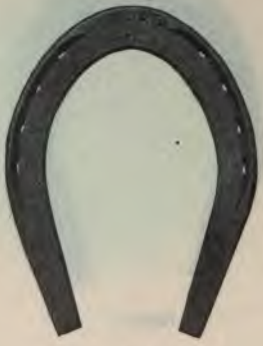
Size	Approximate Weight		Average No. of Shoes in Keg	Size	Approximate Weight		Average No. of Shoes in Keg
	Ounces	Grammes			Ounces	Grammes	
0	10	283	160	0	9	255	178
1	13	368	123	1	10	283	160
2	15½	439	103	2	12	354	133
3	18½	524	86	3	15	425	107
4	22	624	73	4	19	539	84
5	25½	723	63	5	22½	638	71
6	30	850	53	6	26½	751	60
7	39	1106	41	7	31	879	51

Packed in red headed, steel hooped kegs, each containing 100 pounds (45.36 kilos) net.

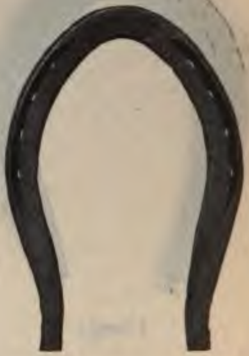
"JUNIATA" HORSE SHOES.—*Continued*

EXTRA LIGHT PATTERN

Steel or Iron



Front



Hind

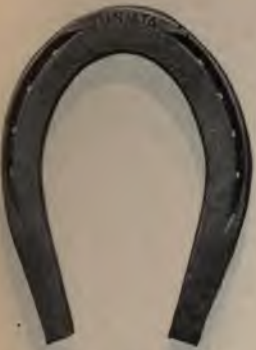
Size	Approximate Weight		Average No. of Shoes in Keg	Size	Approximate Weight		Average No Shoes in K
	Ounces	Grammes			Ounces	Grammes	
0	10	283	160	0	8	227	200
1	13	368	123	1	11½	326	139
2	15½	439	103	2	14	397	114
3	18½	524	86	3	17	482	94
4	22	624	73	4	20	567	80
5	25½	723	63	5	24	680	67
6	30	850	53	6	28	794	57
7	39	1106	41	7	33	936	49

Packed in red headed, steel hooped kegs, each containing 100 poun (45.36 kilos) net.

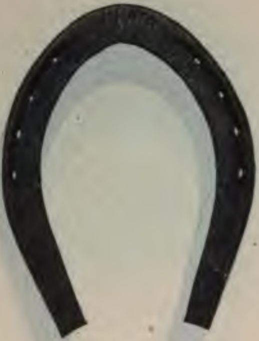
"JUNIATA" HORSE SHOES.—*Continued*

LIGHT PATTERN

Steel or Iron



Front



Hind

Size	Approximate Weight		Average No. of Shoes in Keg	Size	Approximate Weight		Average No. of Shoes in Keg
	Ounces	Grammes			Ounces	Grammes	
00	10	283	160	00	7	198	228
0	11	312	145	0	9	255	178
1	14	397	114	1	12	340	133
2	17	482	94	2	15	425	107
3	20	567	80	3	18	510	89
4	25	709	64	4	22	624	73
5	29	822	55	5	27	765	59
6	36	1020	44	6	31	879	52
7	41	1162	39	7	35	992	46

Can also furnish hind shoes in this pattern with turned-out heels if desired. In ordering state whether turned-in or turned-out heels are wanted on hind shoes.

Packed in red headed, steel hooped kegs, each containing 100 pounds (45.36 kilos) net.

"JUNIATA" HORSE SHOES.—*Continued*

MEDIUM PATTERN

Steel or Iron

Front

Hind

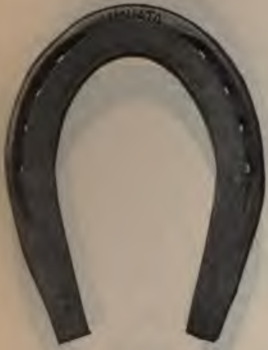
Size	Approximate Weight		Average No. of Shoes in Keg	Size.	Approximate Weight		Average No. of Shoes in Keg
	Ounces	Grammes			Ounces	Grammes	
0	13	368	123	0	10½	298	152
1	17	482	94	1	14	397	114
2	20	567	80	2	17	482	94
3	25	709	64	3	20	567	80
4	29	822	55	4	24	680	67
5	35	992	46	5	29	822	55
6	40	1134	40	6	34	964	47
7	46	1304	35	7	38	1077	42

Packed in red headed, steel hooped kegs, each containing 100 pounds (45.36 kilos) net.

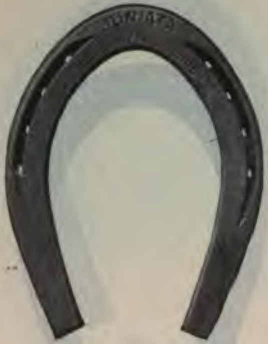
"JUNIATA" HORSE SHOES.—*Continued*

HEAVY PATTERN

Iron or Steel



Front



Hind

ze	Approximate Weight		Average No. of Shoes in Keg	Size	Approximate Weight		Average No. of Shoes in Keg
	Ounces	Grammes			Ounces	Grammes	
	22	624	73	2	18	510	89
	26	737	62	3	22	624	73
	30	850	53	4	28½	808	56
5	36	1020	44	5	33½	950	48
6	43	1219	37	6	38½	1091	42
7	49½	1403	32	7	47	1332	34

Can also furnish hind shoes in this pattern with turned-out heels, if desired. When ordering, state whether turned-in or turned-out heels are wanted on ind shoes.

Packed in red headed, steel hooped kegs, each containing 100 pounds (45.36 ilos) net.

"JUNIATA" HORSE SHOES.—*Continued*

SNOW PATTERN (BEVELED)

Iron or Steel

Front

Hind

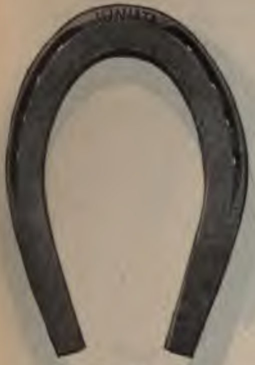
Size	Approximate Weight		Average No. of Shoes in Keg	Size	Approximate Weight	
	Ounces	Grammes			Ounces	Grammes
0	10	283	160	0	8	227
1	12	340	133	1	10½	298
2	15	425	107	2	12½	354
3	18½	524	86	3	16	454
4	23½	666	68	4	19½	553
5	28	794	57	5	23	652
6	32	907	50	6	27	765
7	38	1077	42	7	33	935

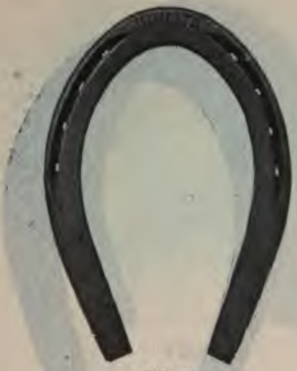
Packed in red headed, steel hooped kegs, each containing 100 p
kilos) net.

"JUNIATA" HORSE SHOES.—*Continued*

CITY PATTERN, LONG HEEL, LIGHT

Steel or Iron


Front


Hind

Size	Approximate Weight		Average No. of Shoes in Keg	Size	Approximate Weight		Average No. of Shoes in Keg
	Ounces	Grammes			Ounces	Grammes	
2	21	595	76	2	17	482	94
3	24¾	702	65	3	22½	638	71
4	30½	865	52	4	27¾	787	58
5	35½	1006	46	5	32	907	50
6	41	1162	39	6	37½	1063	43
7	48¾	1382	33	7	42½	1205	38
8	53¼	1510	30	8	46¼	1311	35

Can furnish hind shoes in this pattern with turned-out heels, if desired.

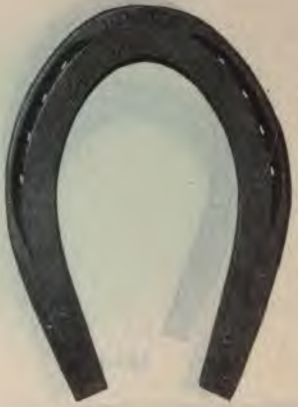
When ordering, state whether turned-in or turned-out heels are wanted on hind shoes.

Packed in red headed, steel hooped kegs, each containing 100 pounds (45.36 kilos) net.

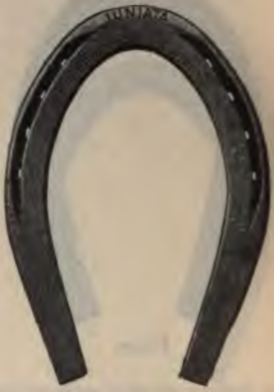
"JUNIATA" HORSE SHOES.—*Continued*

CITY PATTERN, LONG HEEL, MEDIUM

Steel or Iron



Front



Hind

Size	Approximate Weight		Average No. of Shoes in Keg	Size	Approximate Weight		Average N of Shoes in Keg
	Ounces	Grammes			Ounces	Grammes	
3	28¾	815	56	3	25¾	730	63
4	34	964	47	4	32	907	50
5	40	1134	40	5	36	1021	44
6	48¼	1368	33	6	42½	1205	38
7	54½	1545	29	7	47½	1347	34

Packed in red headed, steel hooped kegs, each containing 100 poun (45.36 kilos) net.

"JUNIATA" HORSE SHOES.—*Continued*

"JUNIATA" AFRICAN SPECIAL

Steel

Front

Hind

Size and Pattern	Approximate Dimensions		
	Width Overall	Width of Bar	Thickness of Bar
1 (Medium)	4½ inches	⅝ inch	⅜ inch
2 (Medium)	4¾ "	¾ "	⅜ "
3 (Medium)	5 "	¾ "	⅜ "
4 (Medium)	5¼ "	¾ "	⅜ "
4 (Extra heavy)	5¼ "	¾ "	½ "
5 (Extra heavy)	5½ "	⅞ "	½ "
6 (Extra heavy)	5¾ "	⅞ "	½ "

Can also be furnished with toe clips.

Packed in red headed, steel hooped kegs, each containing 100 pounds (45.36 kilos) net.

"JUNIATA" BRONCO SHOES

Steel

Plain Heel Beveled

Turned Heel Beveled

Turned Heel Square Edge

Size	Approximate Weight		Average of Shoe in Keg
	Ounces	Grammes	
00	8	227	200
0	9	255	178
1	11	312	145
2	13	368	123
3	15	425	107
00	9	255	178
0	10	283	160
1	12	340	133
2	14	397	114
3	16	454	100
00	9½	269	170
0	10½	298	152
1	12	340	133
2	14½	411	110
3	15½	439	103

Packed in red headed, steel hooped kegs, each containing 100 pounds (45 kilos) net.

"JUNIATA" PONY SHOES

COUNTERSUNK PATTERN

Steel

Front

Hind

Size	Approximate Weight		Average No. of Shoes in Keg	Size	Approximate Weight		Average No. of Shoes in Keg
	Ounces	Grammes			Ounces	Grammes	
1	6¾	191	237	1	5½	156	291
2	8	227	200	2	7½	213	213
3	9½	269	168	3	8¾	248	183
4	11	312	145	4	10	283	160

Packed in red headed, steel hooped kegs, each containing 100 pounds (45.36 kilos) net.

"JUNIATA" MULE AND JACK SHOES

MULE SHOES

Light Pattern, Steel; Heavy Pattern, Steel or Iron

Size	Approximate Weight				Average No. of Shoes in Keg	
	Light Pattern		Heavy Pattern			
	Ounces	Grammes	Ounces	Grammes	Light	Heavy
00	8	227			200	
0	9	255			178	
1	10	283	12½	354	160	128
2	12	340	16	454	133	100
3	15	425	20	567	107	80
4	20	567	24	680	80	67
5	23	652	28	794	70	57
6	30	850	33	935	53	48

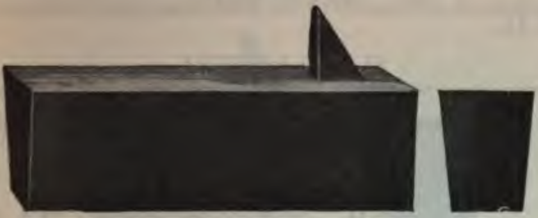
Jack Shoes—Steel

JACK SHOES made in one size only—6 ounces (1 grammes). Average number of shoes in keg, 267.

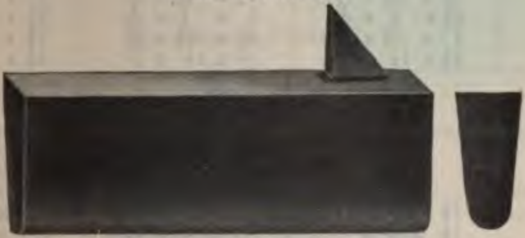
Packed in red headed, steel hooped kegs, each containin 100 pounds (45.36 kilos) net.

"JUNIATA" TOE CALKS

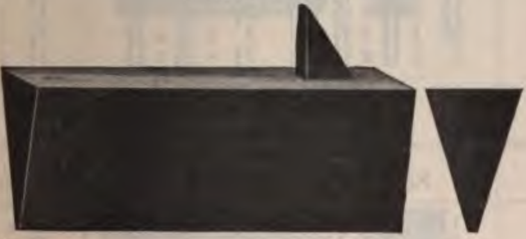
BLUNT PATTERN



MEDIUM PATTERN



SHARP PATTERN



These are the latest and most improved patterns of Toe Calks. The spur placed far enough from the end to avoid striking the crease, and is hard ugh to insure driving into the shoe without bending. To secure the best aring qualities, the calks should be tempered at a cherry red heat just ore driving. To obtain best welding results, the shoe should not be plunged o water, but allowed to cool gradually.

or sizes of "Juniata" Toe Calks, see next page.

"JUNIATA" TOE CALKS

Sizes and dimensions in inches

(For equivalents in millimeters of the dimensions given below, see table on pages 14 and 15.)

BLUNT PATTERN

Size	Regular	Long	Extra Long
No. 0	1¼ x 7/16 x ⅜	1½ x 7/16 x ⅜	1¾ x 7/16 x ⅜
" 1	1½ x ½ x ⅜	1¾ x ½ x ⅜	2 x ½ x ⅜
" 2	1¾ x 9/16 x 7/16	2 x 9/16 x 7/16	2¼ x 9/16 x 7/16
" 3	2 x ⅝ x ½	2¼ x ⅝ x ½	2½ x ⅝ x ½
" 4	2¼ x ¾ x ½	2½ x ¾ x ½	2¾ x ¾ x ½
" 5	2½ x 13/16 x 9/16	2¾ x 13/16 x 9/16	3 x 13/16 x 9/16
" 6	2¾ x ⅞ x 9/16	3 x ⅞ x 9/16	3¼ x ⅞ x 9/16
" 7	3 x 15/16 x 19/32	3¼ x 15/16 x 19/32	3½ x 15/16 x 19/32
" 8	3¼ x 1⅛ x ⅝	3½ x 1⅛ x ⅝	3¾ x 1⅛ x ⅝

MEDIUM PATTERN

Size	Regular	Long	Extra Long
No. 0	1⅜ x 15/32 x 5/16	1⅝ x 15/32 x 5/16	1⅞ x 15/32 x 5/16
" 1	1½ x 17/32 x 5/16	1¾ x 17/32 x 5/16	2 x 17/32 x 5/16
" 2	1¾ x 21/32 x 11/32	2 x 21/32 x 11/32	2¼ x 21/32 x 11/32
" 3	2 x ¾ x 13/32	2¼ x ¾ x 13/32	2½ x ¾ x 13/32
" 4	2¼ x 27/32 x 7/16	2½ x 27/32 x 7/16	2¾ x 27/32 x 7/16
" 5	2½ x 27/32 x 7/16	2¾ x 27/32 x 7/16	3 x 27/32 x 7/16
" 6	2¾ x 15/16 x 17/32	3 x 15/16 x 17/32	3¼ x 15/16 x 17/32
" 7	3 x 31/32 x 17/32	3¼ x 31/32 x 17/32	3½ x 31/32 x 17/32

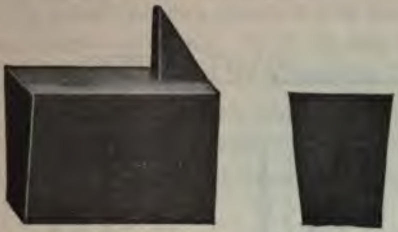
SHARP PATTERN

Size	Regular	Long	Extra Long
No. 0	1½ x ½ x 5/16	1¾ x ½ x 5/16	2 x ½ x 5/16
" 1	1¾ x ⅝ x ⅜	2 x ⅝ x ⅜	2¼ x ⅝ x ⅜
" 2	2 x ¾ x 15/32	2¼ x ¾ x 15/32	2½ x ¾ x 15/32
" 3	2¼ x ⅞ x ½	2½ x ⅞ x ½	2¾ x ⅞ x ½
" 4	2½ x 15/16 x 17/32	2¾ x 15/16 x 17/32	3 x 15/16 x 17/32
" 5	2¾ x 1 x 9/16	3 x 1 x 9/16	3¼ x 1 x 9/16
" 6	3 x 1 1/16 x ⅝	3¼ x 1 1/16 x ⅝	3½ x 1 1/16 x ⅝
" 7	3¼ x 1⅛ x 11/16	3½ x 1⅛ x 11/16	3¾ x 1⅛ x 11/16

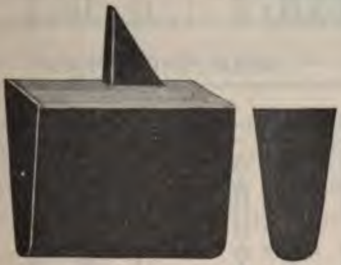
Packed in boxes of 25 pounds (11.34 kilos) net.

"JUNIATA" HEEL CALKS

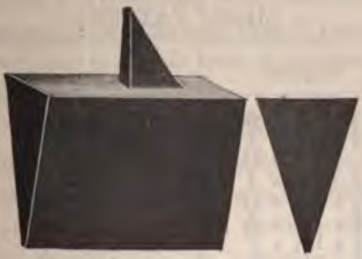
BLUNT PATTERN



MEDIUM PATTERN



SHARP PATTERN



zes, see next page.

"JUNIATA" HEEL CALKS

Sizes and dimensions in inches

(For equivalents in millimeters of the dimensions given below, see table on pages 14 and 15.)

BLUNT PATTERN

Size	Regular	Long	Extra Long
No. 0	7/8 x 7/16 x 3/8	1 x 7/16 x 3/8	1 1/8 x 7/16 x 3/8
" 1	7/8 x 1/2 x 3/8	1 x 1/2 x 3/8	1 1/8 x 1/2 x 3/8
" 2	7/8 x 9/16 x 7/16	1 x 9/16 x 7/16	1 1/8 x 9/16 x 7/16
" 3	1 x 5/8 x 1/2	1 1/8 x 5/8 x 1/2	1 1/4 x 5/8 x 1/2
" 4	1 1/8 x 3/4 x 1/2	1 1/4 x 3/4 x 1/2	1 3/8 x 3/4 x 1/2
" 5	1 1/4 x 13/16 x 9/16	1 3/8 x 13/16 x 9/16	1 1/2 x 13/16 x 9/16
" 6	1 3/8 x 7/8 x 9/16	1 1/2 x 7/8 x 9/16	1 5/8 x 7/8 x 9/16
" 7	1 1/2 x 29/32 x 19/32	1 5/8 x 29/32 x 19/32	1 3/4 x 29/32 x 19/32
" 8	1 5/8 x 1 1/8 x 5/8	1 3/4 x 1 1/8 x 5/8	1 7/8 x 1 1/8 x 5/8

MEDIUM PATTERN

Size	Regular	Long	Extra Long
No. 0	7/8 x 15/32 x 5/16	1 x 15/32 x 5/16	1 1/8 x 15/32 x 5/16
" 1	7/8 x 17/32 x 5/16	1 x 17/32 x 5/16	1 1/8 x 17/32 x 5/16
" 2	7/8 x 21/32 x 11/32	1 x 21/32 x 11/32	1 1/8 x 21/32 x 11/32
" 3	1 x 3/4 x 13/32	1 1/8 x 3/4 x 13/32	1 1/4 x 3/4 x 13/32
" 4	1 1/8 x 27/32 x 7/16	1 1/4 x 27/32 x 7/16	1 3/8 x 27/32 x 7/16
" 5	1 1/4 x 27/32 x 7/16	1 3/8 x 27/32 x 7/16	1 1/2 x 27/32 x 7/16
" 6	1 3/8 x 15/16 x 17/32	1 1/2 x 15/16 x 17/32	1 5/8 x 15/16 x 17/32
" 7	1 1/2 x 31/32 x 17/32	1 5/8 x 31/32 x 17/32	1 3/4 x 31/32 x 17/32

SHARP PATTERN

Size	Regular	Long	Extra Long
No. 0	7/8 x 1/2 x 5/16	1 x 1/2 x 5/16	1 1/8 x 1/2 x 5/16
" 1	7/8 x 5/8 x 3/8	1 x 5/8 x 3/8	1 1/8 x 5/8 x 3/8
" 2	1 x 3/4 x 15/32	1 1/8 x 3/4 x 15/32	1 1/4 x 3/4 x 15/32
" 3	1 1/8 x 7/8 x 1/2	1 1/4 x 7/8 x 1/2	1 3/8 x 7/8 x 1/2
" 4	1 1/4 x 15/16 x 17/32	1 3/8 x 15/16 x 17/32	1 1/2 x 15/16 x 17/32
" 5	1 3/8 x 1 x 9/16	1 1/2 x 1 x 9/16	1 5/8 x 1 x 9/16
" 6	1 1/2 x 1 1/16 x 5/8	1 5/8 x 1 1/16 x 5/8	1 3/4 x 1 1/16 x 5/8
" 7	1 5/8 x 1 1/8 x 11/16	1 3/4 x 1 1/8 x 11/16	1 7/8 x 1 1/8 x 11/16

Packed in boxes of 25 pounds (11.34 kilos) net.

BILLETS, BLOOMS AND SLABS

We can offer subject to Mill conditions, Steel Billets, Blooms and Slabs the following dimensions:

Billets—1⅜, 1½, 1⅝, 1¾, 2 and 2½ inches square, in lengths of 15, 20, 25 and 0 feet. (Approximate metric equivalents: 35, 38, 41, 44½, 51 and 63½ millieters square by 4.572, 6.096, 7.620 and 9.144 meters long.)

Billets—4 x 4, 5 x 4, 6 x 4, 6 x 5 and 6 x 6 inches, in any desired lengths om 2 to 9 feet inclusive. (Approximate metric equivalents: 102 x 102, 127 x 02, 152 x 102, 152 x 127 and 152 x 152 millimeters by 62 to 274 centimeters ong.)

Rolling Mill Blooms—6, 6½, 7, 7½, 8, 8½, 9, 9½, 10 and 12 inches square, in lengths of not less than 4 feet nor more than 9 feet. (Approximate metric equivalents: 152, 165, 178, 191, 203, 216, 229, 241, 254 and 305 millimeters square by from 1.219 meters minimum, to 2.743 meters maximum, long).

Forge Blooms cannot be furnished with either cross sectional dimensions greater than 6 inches (152 millimeters).

Slabs can be furnished in widths of 8 to 16 inches (203 to 406 millimeters), inclusive, not thinner than 4 inches (102 millimeters) nor thicker than 8 inches (203 millimeters). Slabs over 15 inches (381 millimeters) wide must not exceed 6 inches (152 millimeters) in thickness. The widths and thicknesses of slabs vary by half inches (12.70 millimeters).

SHEET AND TIN PLATE BARS

We can offer, subject to Mill conditions, Steel Sheet and Tin Plate Bars 8 inches (203 millimeters) wide in weights from 7½ to 37½ pounds per foot (11.16 to 55.80 kilos per meter) and in lengths from 15 to 30 feet (4.572 meters to 9.144 meters).

FERRO MANGANESE

We are prepared to sell Ferro Manganese for export. If shipped from Northern Ports the ferro manganese will be produced by furnaces of the Carnegie Steel Company. If shipped from Southern Ports the ferro manganese will be produced by furnaces of the Tennessee Coal, Iron & Railroad Company

PIG IRON

The Pig Iron we sell is produced by the Tennessee Coal, Iron & Rail Company at furnaces in Alabama and Tennessee. The most conver ports of shipment are Savannah, Pensacola, Mobile, New Orleans and c ports in the South of the United States. Shipment from Northern Por not usually practicable, on account of the cost of delivery from the furnac

Basic Pig Iron may be either machine cast or chill cast, at seller's optic

Below we give guaranteed analysis of our Standard Basic Pig Iron.

STANDARD BASIC PIG IRON

Silicon	not over 1.00
Phosphorus	" " 1.00
Sulphur	" " .05
Manganese	" " .60

Foundry Pig Iron may be graded by either analysis or fracture, bu both, and the buyer, when ordering, has the privilege of specifying mode of determining the grade. When Iron is sold to be graded by an we do not guarantee fracture; when sold to be graded by fracture, we d guarantee analysis, nor do we furnish the buyer with an analysis.

Pig Iron.—*Continued*

When Iron is sold by analysis, without regard to fracture, the following limits chemical composition will determine the grade:

FOUNDRY PIG IRON

Sand Cast, Machine Cast, or Chill Cast, at Seller's option.

	Equivalent of No. 1 Soft	Equivalent of No. 2 Soft	Equivalent of No. 2 Foundry
	Per Cent.	Per Cent.	Per Cent.
Silcon	2.75 to 3.25	2.25 to 2.75	2.00 to 2.50
Sulphur	Not over .05	Not over .05	Not over .05
Phosphorus	.70 to 1.00	.70 to 1.00	.70 to 1.00
Manganese	.16 to .40	.16 to .40	.16 to .40

	Equivalent of No. 3 Foundry	Equivalent of No. 4 Foundry
	Per Cent.	Per Cent.
Silicon	1.75 to 2.25	1.25 to 1.75
Sulphur	Not over .05	Not over .06
Phosphorus	.70 to 1.00	.70 to 1.00
Manganese	.16 to .40	.16 to .40

COAL

We offer for shipment from Southern ports (Mobile, Pensacola, New Orleans, Savannah, Brunswick, etc.) coal for steam and other purposes from the mines of the Tennessee Coal, Iron & Railroad Company.

"Pratt" Coal, from mines near Ensley and Pratt City, Alabama, is probably the most efficient steam coal produced in the Southern States and for evaporating power has few equals among the bituminous coals of the United States.

"Pratt" Screened Lump Coal has shown by analysis and actual test 14,500 British Thermal Heat Units per pound of coal. The following are average analyses:

	"Pratt" Screened Lump Coal	"Pratt" Run of Mines (Unscreened)
	Per Cent.	Per Cent.
Moisture	1.50	1.50
Fixed Carbon	60.20	59.80
Volatile Matter	31.65	30.20
Ash	5.40	7 to 8
Sulphur	1.25	1.50

COAL.—*Continued*

"Blocton" Coal, mined at Blocton, Alabama, is a very high grade gas c by reason of the high percentage of volatile matter carried. This coal is a regarded by many consumers as superior to the "Pratt" coal for steam p poses, by reason of its quick burning properties. The following are aver analyses:

	"Blocton" Lump	"Blocton" Run of Min (Unscreened)
	Per Cent.	Per Cent.
Moisture	0.75	0.80
Fixed Carbon	56.87	55.87
Volatile Matter	37.23	35.23
Ash	4.88	7.88
Sulphur	0.66	0.75

COKE

The Tennessee Coal, Iron & Railroad Company produce three varietie Coke—"Pratt" (Semet-Solvay and Koppers by-Product Process), thorou screened, excellent structure and very efficient; "Blue Creek and Pratt M Coke" (Koppers Ovens), a product which shows a very low sulphur an especially adapted for foundry purposes; and the "Whitwell Bee-hive Co The Pratt and Blue Creek coals are thoroughly washed before coking, "Whitwell Coke" being made from an unwashed coal. Below we give analyses of the Cokes above referred to:

	"Pratt"	"Blue Creek and Pratt Mixed"	"Whitwell"
	Per Cent.	Per Cent.	Per Cent.
Fixed Carbon	90.04	88.41	86.55
Ash	9.30	10.42	12.43
Sulphur	1.13	.84	.78
Volatile Matter	.36	1.17	.42
Moisture	.30	1.00	.59

RAILWAY AND TRAMWAY SECTION

STEEL RAILS AND ACCESSORIES
STEEL CROSS TIES
POINTS, CROSSINGS, AND OTHER SPECIAL WORK
FOR RAILWAYS AND TRAMWAYS
COPPER RAIL BONDS

SOLID WROUGHT STEEL WHEELS
STEEL AXLES AND SIMILAR FORGINGS

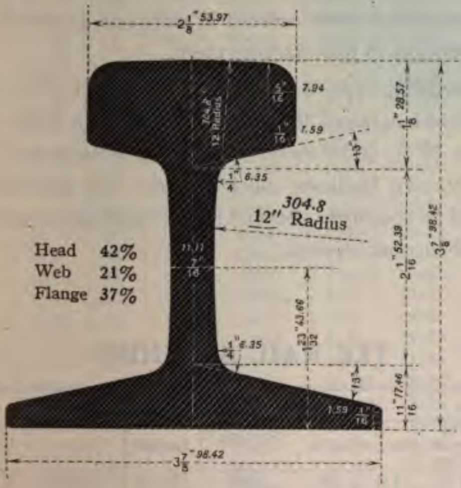
BOILER AND FIREBOX STEEL FOR LOCOMOTIVES
BOILER RIVET STEEL
LOCOMOTIVE TUBES—SUPERHEATER TUBES
SIGNAL PIPE

TUBULAR POLES and "SHIFFLER" POLES
FOR TRAMWAYS, ELECTRIC TRANSMISSION LINES, ETC.

STEEL RAILS AND ACCESSORIES

tandard Specifications for Steel Rails and Accessories, used by Carnegie ompany, Illinois Steel Company and Tennessee Coal, Iron and Railroad ny, see pages 316 to 327, 333 to 335, 339, 340 and 343 to 345.

illustration below represents the standard American type of Tee Rail, d on the lines recommended by the American Society of Civil Engineers, general use by a large majority of American railway companies.



ction No. 5040, weighing 50 lbs. per yard (24.80 kilos per meter)

other weights (from 8 to 110 lbs. per yard—3.97 to 54.57 kilos per see tables on pages 312 to 315.

further details see Rail Catalogues of United States Steel Products ny, Carnegie Steel Company, Illinois Steel Company and Tennessee Iron & R. R. Co., which will be furnished on request to Engineers, ctors, Railway Companies and others interested in railway construction intenance.

STANDARD SECTIONS OF TEE RAILS AND ACCESSORIES

Sections appearing below, representing those for which we have
the present time, include American Society of Civil Engineers' sectio
minating with the numeral 40). The American Railway Associatio
"A," is represented by a terminal numeral 20, and type "B" by te
numeral 30. The other sections are special for which rolls have bee
pared, principally for export orders. Rails and accessories of other
sections can be furnished when ordered in sufficient quantity to justi
paration of special rolls to manufacture them.

Light Rails, weighing from 8 to 45 lbs. per yard (3.97 k. to 22.32
meter), all standard lengths of 30 ft. (9.14 meters) with 10% of short l
varying down to 20 ft. (6.10 meters), are kept in stock and can usu
shipped promptly. To facilitate quick delivery, our standard length
accessories should be specified. Special lengths and special drilling or
ing can be furnished when desired.

TEE RAIL SECTIONS

Rail Section	Weight		Height		Splice Bar Section	Size of Bolt		Size of Sp	
	Per Yard, Lbs.	Per Meter, Kilos	Inches	m/m		Inches	m/m	Inches	m
840	8	3.97	1 9/16	40	S840	3/8x1 3/8	9.5x34.9	2 1/2x 5/16	63.
1040	10	4.96	1 3/4	44	S1040	3/8x1 1/2	9.5x38.1	2 1/2x 5/16	63.
1240	12	5.95	2	51	S1240	1/2x1 3/4	12.7x44.4	3 x 3/8	76.
1440	14	6.94	2 1/16	52	S1440	1/2x1 3/4	12.7x44.4	3 x 3/8	76.
1640	16	7.94	2 3/8	60	S1640	1/2x1 3/4	12.7x44.4	3 1/2x 3/8	88.
1840	18	8.93	2 3/8	60	S1640	1/2x1 7/8	12.7x47.6	3 1/2x 3/8	88.
19.2-86	19.2	9.52	2 23/64	60	S19.2-86	7/16x1 37/64	11.1x40	......	...
2040	20	9.92	2 5/8	67	S2040	1/2x2	12.7x50.8	3 1/2x 1/2	88.
20.2-86	20.2	10.00	2 107/128	72	S20.2-86	33/64x1 109/128	13.1x47	......	...
2486	24	12.00	3 19/128	80	S2486	5/8x2 1/2	15.9x63.5	4 x 1/2	101.
2540	25	12.40	2 3/4	70	S2540	1/2x2 1/8	12.7x54	4 x 1/2	101.
27.1-86	27.1	13.44	2 53/64	72	.....	......	....	......	...
27.9-86	27.9	13.84	3 1/8	79	S27.9-86	5/8x2 3/8	16x60	4 x 1/2	101.
3040	30	14.88	3 1/8	79	S3040	5/8x2 1/2	16x63	4 x 1/2	101.
30.5-77	30.5	15.13	3 7/64	79	S30.5-77	19/32x2 9/16	15x65	......	....
3540	35	17.36	3 5/16	84	S3540	5/8x2 1/2	16x63	4 1/2x 1/2	114.
4040	40	19.84	3 1/2	89	S4040	3/4x2 7/8	19x73	5 x 1/2	127
4075	40	19.84	3 55/64	98	S4075	19/32x2 7/16	15x62	......	...

STANDARD SECTIONS OF TEE RAILS

Continued

Weight		Height		Splice Bar Section	Size of Bolt		Size of Spike	
Per Yard, Lbs.	Per Meter, Kilos	Inches	m/m		Inches	m/m	Inches	m/m
40.3	19.99	3 95/128	95	S40.3-75 S40.3-75A	43/64x2 61/64	17x75	.....	....
42	20.83	3 15/16	100	S4275	3/4x2 5/8	19x67	.....	....
45	22.32	3 11/16	94	S4540	3/4x3	19x76	5 1/2x 9/16	140x14.3
46.4	23.01	4 29/64	113	S46.4-75	25/32x3 3/8	20x86	.....	....
48	23.81	3 11/16	94	S4540	3/4x3	19x76	5 1/2x 9/16	140x14.3
50	24.80	3 7/8	98	S5040	3/4x3 1/8	19x79	5 1/2x 9/16	140x14.3
50	24.80	3 15/16	100	S5090	3/4x3 1/2	19x89	.....	....
50.4	25.00	3 15/16	100	S50.4-77	25/32x3 3/8	20x86	.....	....
50.4	25.00	4 5/64	103	D50.4-75	25/32x3 3/4	20x95	.....	....
51.4	25.49	4 9/64	105	S51.4-77	23/32x3 3/16	18x81	.....	....
54.4	26.98	4 3/8	111	S54.4-77	13/16x3 1/2	21x89	.....	....
55	27.28	4 1/16	103	S5540	3/4x3 3/8	19x86	5 1/2x 9/16	140x14.3
56	27.78	4 1/4	108	S7033	3/4x3 3/4	19x95	5 1/2x 9/16	140x14.3
56	27.78	4 1/4	108	S6051	3/4x3 3/4	19x95	5 1/2x 9/16	140x14.3
60	29.76	4 1/4	108	S6040	3/4x3 1/2	19x89	5 1/2x 9/16	140x14.3
60	29.76	4 1/4	108	S7033	3/4x3 7/8	19x98	5 1/2x 9/16	140x14.3
60	29.76	4 1/2	114	S6020	3/4x3 5/8	19x92	5 1/2x 9/16	140x14.3
60	29.76	4 3/16	106	S6030	3/4x3 5/8	19x92	5 1/2x 9/16	140x14.3
60	29.76	4 3/8	111	D6077	3/4x3 7/8	19x98	.....	....
60	29.76	4 1/4	108	S6078	3/4x3 1/2	19x89	.....	....
60.5	30.01	4 59/64	125	S60.5-75	7/8x3 3/4	22x95	.....	....
60.5	30.01	4 1/4	108	S60.5-77	3/4x3 15/16	19x100	.....	....
62	30.76	4 3/4	121	S6275	3/4x3 3/4	19x95	6 3/32x 9/16	155x14.3
62.5	31.00	4 17/32	115	D62.5-75	51/64x4 3/32	20x104	.....	....
65	32.24	4 7/16	113	S6540	3/4x3 5/8	19x92	5 1/2x 9/16	140x14.3
67.5	33.49	5 5/128	128	S67.5-75	3/4x3 3/4	19x95	6 7/16x 5/8	164x15.9
70	34.72	4 5/8	117	S7040	3/4x3 3/4	19x95	5 1/2x 9/16	140x14.3
70	34.72	4 3/4	121	S7020	3/4x3 3/4	19x95	5 1/2x 9/16	140x14.3
70	34.72	4 35/64	115	S7030	3/4x4	19x102	5 1/2x 9/16	140x14.3
70	34.72	4 1/2	114	S7033	3/4x3 3/4	19x95	5 1/2x 9/16	140x14.3
70.56	35.00	4 103/128	121	D70.5-75	51/64x4 1/8	20x105	.....	....
72	35.71	4 3/4	120	S7250	3/4x3 1/4	19x83	5 1/2x 9/16	140x14.3
72.8	36.11	4 63/64	127	S72.8-75	7/8x3 7/8	22x98	.....	....
75	37.20	4 13/16	122	S7540	7/8x4	22x102	5 1/2x 9/16	140x14.3
75	37.20	4 3/4	121	S7550	7/8x4	22x102	5 1/2x 9/16	140x14.3
75	37.20	4 15/16	125	S7524	7/8x3 7/8	22x98	5 1/2x 9/16	140x14.3
75	37.20	5	127	S7522	3/4x3 7/8	19x98	5 1/2x 9/16	140x14.3
75	37.20	4 57/64	124	S7577	7/8x4 3/8	22x111	.....	....

Standard Sections of Tee Rails

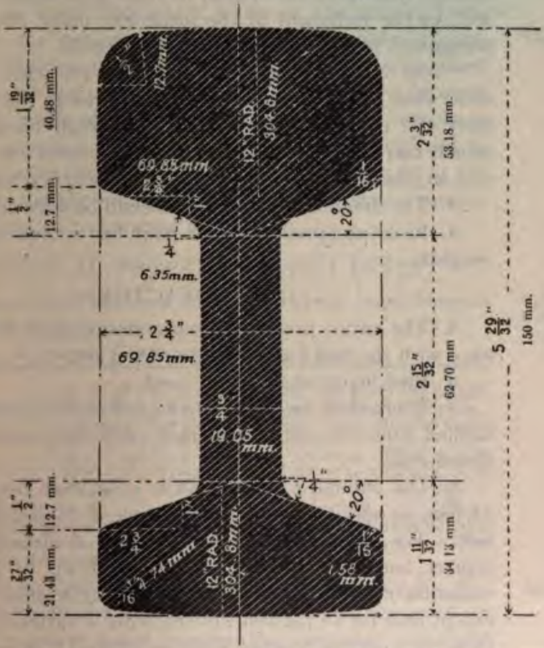
Continued

Rail Section	Weight		Height		Splice Bar Section	Size of Bolt		Size of Spike	
	Per Yard, Lbs.	Per Meter, Kilos	Inches	m/m		Inches	m/m	Inches	m/m
7578	75	37.20	5	127	S7578	$\frac{7}{8}$x4$\frac{1}{8}$	22x105	....	....
77.6–77	77.6	38.49	5$\frac{1}{32}$	128	S77.6–77	$\frac{15}{16}$x3$\frac{11}{16}$	24x94	....	....
8040	80	39.68	5	127	S8040	$\frac{7}{8}$x4$\frac{1}{8}$	22x105	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
8010	80	39.68	5	127	S8010	$\frac{15}{16}$x4$\frac{3}{8}$	24x111	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
8020	80	39.68	5$\frac{1}{8}$	130	S8020	$\frac{7}{8}$x4$\frac{1}{8}$	22x105	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
8030	80	39.68	4$\frac{15}{16}$	125	S8030	$\frac{7}{8}$x4$\frac{1}{4}$	22x108	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
8022	80	39.68	5$\frac{1}{8}$	130	S8022	$\frac{13}{16}$x4$\frac{1}{8}$	21x105	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
8077	80	39.68	5	127	S8077	$\frac{3}{4}$x4$\frac{1}{4}$	19x108	....	....
8078	80	39.68	5$\frac{1}{4}$	133	S8078 S8078 A	1x4$\frac{1}{2}$	25.4x114	....	....
8079	80	39.68	5$\frac{1}{16}$	129	S8079	$\frac{7}{8}$x4$\frac{5}{16}$	22x110	....	....
80.2–77	80.2	39.78	4$\frac{57}{64}$	124	S80.2–77	$\frac{7}{8}$x3$\frac{15}{16}$	22x100	....	....
8540	85	42.16	5$\frac{3}{16}$	132	S8540	$\frac{7}{8}$x4$\frac{1}{8}$	22x105	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
8550	85	42.16	5$\frac{7}{32}$	133	S8550	$\frac{7}{8}$x4$\frac{1}{2}$	22x114	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
8520	85	42.16	5$\frac{3}{8}$	137	S8520	$\frac{7}{8}$x4$\frac{1}{4}$	22x108	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
8521	85	42.16	5$\frac{3}{8}$	137	S8521	1x4$\frac{5}{8}$	25.4x117	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
8522	85	42.16	5$\frac{1}{4}$	133	D8522	$\frac{7}{8}$x4$\frac{1}{2}$	22x114	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
8531	85	42.16	5$\frac{1}{8}$	130	S8531	$\frac{13}{16}$x4$\frac{1}{2}$	21x114	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
8524	85	42.16	5$\frac{1}{8}$	130	S8524	$\frac{7}{8}$x4$\frac{3}{8}$	22x111	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
8575	85	42.16	5$\frac{1}{4}$	133	S8575	$\frac{7}{8}$x4$\frac{3}{4}$	22x121	....	....
88.5–77	88.5	43.90	4$\frac{31}{32}$	126	S88.5–77	$\frac{7}{8}$x3$\frac{15}{16}$	22x100	....	....
9040	90	44.64	5$\frac{3}{8}$	137	S9040	1x4$\frac{3}{8}$	25.4x111	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
9020	90	44.64	5$\frac{5}{8}$	143	S9020	1x4$\frac{1}{2}$	25.4x114	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
9030	90	44.64	5$\frac{17}{64}$	134	S9030	1x4$\frac{5}{8}$	25.4x117	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
9034	90	44.64	5$\frac{3}{8}$	137	S9034	1$\frac{1}{16}$x4$\frac{1}{2}$	27x114	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
9021	90	44.64	5$\frac{5}{8}$	143	D9020 S9021	1x4$\frac{5}{8}$ $\frac{7}{8}$x4$\frac{3}{4}$	25.4x117 22x121	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
9023	90	44.64	5$\frac{3}{4}$	146	S9023	1x4$\frac{5}{8}$	25.4x117	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
9085	90	44.64	5$\frac{5}{8}$	143	D9085	$\frac{7}{8}$x5$\frac{1}{2}$	22x140	....	....
9133	91	45.14	5$\frac{1}{4}$	133	S9133	$\frac{15}{16}$x4$\frac{7}{8}$	24x124	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
10040	100	49.60	5$\frac{3}{4}$	146	S10040	1x4$\frac{5}{8}$	25.4x117	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
10020	100	49.60	6	152	S10020	1x4$\frac{5}{8}$	25.4x117	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
10030	100	49.60	5$\frac{41}{64}$	143	S10030	1x4$\frac{5}{8}$	25.4x117	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
10034	100	49.60	6	152	S10034	$\frac{7}{8}$x4$\frac{3}{4}$	22x121	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
10032	100	49.60	5$\frac{5}{8}$	143	S10032	$\frac{7}{8}$x4$\frac{3}{4}$	22x121	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3
10050	100	49.60	5$\frac{9}{16}$	141	S10050	$\frac{7}{8}$x5$\frac{5}{8}$	22x143	5$\frac{1}{2}$x$\frac{9}{16}$	140x14.3

STANDARD SECTIONS OF TEE RAILS
Continued

Weight		Height		Splice Bar Section	Size of Bolt		Size of Spike	
Per Yard, Lbs.	Per Meter, Kilos	Inches	m/m		Inches	m/m	Inches	m/m
100	49.60	5 9/16	141	S10050	7/8x5 5/8	22x143	5 1/2x 9/16	140.x14.3
100	49.60	5 29/32	150	S10077	7/8x4 3/4	22x121	.....	....
100	49.60	6	152	S10078 S10078A	1x4 1/2	25.4x114	.....	....
100	49.60	5 13/16	148	S10079	1x4 13/16	25.4x122	.....	....
110	54.56	6	152	S11033 S11033A	1x4 3/4	25.4x121	5 1/2x 9/16	140x14.3

BULL HEAD RAILS



e above illustration represents British Standard Section, weighing 100 er yard (49.61 kilos per meter). Rails of this type, of weights specified rchasers, can be furnished when ordered in quantities sufficient to justify reparation of special rolls to manufacture them.

STANDARD SPECIFICATIONS FOR ACID BESSEMER STEEL RAILS

USED BY THE

CARNEGIE STEEL COMPANY, ILLINOIS STEEL COMPANY,
TENNESSEE COAL, IRON AND RAILROAD COMPANY

(For the Metric equivalents of the dimensions and weights given in these specifications, refer to the tables on Pages 13 to 28.)

No. 1 Rails

1. No. 1 classification rails shall be free from injurious defects and flaws of all kinds.

No. 2 Rails

2. (*a*) Rails which by reason of surface imperfections, are not classed as No. 1 rails, will be accepted as No. 2 rails; but rails which have flaws more than ¼-inch in depth, and which contain imperfections in such number or of such character as will, in the judgment of the inspector, make them unfit for recognized No. 2 uses, will not be accepted.

(*b*) No. 2 rails to the extent of five per cent. of the whole order shall be accepted. All rails accepted as No. 2 rails shall have the ends painted white. They shall have two prick punch marks beside the heat number nearest the end of the rail, so placed as not to be covered by the splice bars.

Classes

3. The different classes of rails shall be kept separate.

Payment

4. Rails accepted shall be paid for according to actual weights.

I. MANUFACTURE

Manufacture

5. The entire process of manufacture shall be in accordance with the best current state of the art.

6. Bled ingots shall not be used.

Discard

7. There shall be cut from the end of the bloom and rail, formed from the top of the ingot, sufficient metal to secure sound rails.

Lengths

8. The standard length of the rails shall be 30 feet, or 33 feet, as specified, at a temperature of 60 degrees Fahrenheit. Ten per cent. of the entire order shall be accepted in shorter lengths varying by one foot down to 24 feet. A variation of ¼-inch from the specified lengths shall be allowed, except that for 15 per cent. of the order a variation of ⅜ inch from the specified lengths shall be allowed. Where rails are ordered in lengths greater than standard, proportional variations shall be allowed. Short length No. 1 rails shall be

STANDARD SPECIFICATIONS FOR ACID BESSEMER STEEL RAILS.—*Continued*

painted green on both ends. If specified in the contract that the rails shall be machined to length cold, a variation of ⅛ inch from the length specified shall be permitted.

Shrinkage

9. (*a*) The number of passes and speed of train shall be so regulated that on leaving the rolls at the final pass, the temperature of the rail shall not exceed that which requires a shrinkage allowance, at the hot saws, of seven inches for a rail 33 feet in length and of 100-pound section, and in the proportion of ⅛ inch less for each ten pound decrease in section, and ⅛ inch more for each ten pound increase in section.

(*b*) The bars shall not be held for the purpose of reducing their temperature, nor shall any artificial means of cooling them be used after they leave the finishing pass. Rails shall be protected from snow and water while on the cooling beds.

Templates

10. Before the general manufacture of the rails is commenced, the manufacturer shall, if required by the engineer (or by the purchaser), supply two sets of templates, internal and external, made of approved material. These templates engraved as specified in the contract, shall be submitted to the engineer (or to the purchaser) for his approval, and at the commencement of the rolling the engineer shall have a competent person present to approve the section.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition

11. The steel shall conform to the following requirements as to chemical composition.

WEIGHT OF RAILS IN POUNDS PER YARD

	45 to 60 Pounds, Per Cent.	61 to 70 Pounds, Per Cent.	71 to 80 Pounds, Per Cent.	81 to 90 Pounds, Per Cent.	91 to 100 Pounds, Per Cent.
Carbon............	.30 to .40	.35 to .45	.35 to .45	.40 to .50	.40 to .50
Manganese.........	.70 to 1.00	.70 to 1.00	.70 to 1.00	.80 to 1.10	.80 to 1.10
Silicon, not over....	.20	.20	.20	.20	.20
Phosphorus, not over	.10	.10	.10	.10	.10

NOTE: If desired by the purchaser, an endeavor shall be made to keep the average percentage of carbon in an entire order of rails as high as the mean between the upper and lower limits specified.

Analyses

12. (*a*) An analysis of each melt shall be made by the manufacturer to determine the percentage of carbon; and an analysis every twelve hours, representing each day and night turn, to determine the average percentages of carbon, manganese, phosphorus and silicon. These analyses shall

be made from drillings taken at least ⅛ inch beneath the surface of a test ingot taken during the pouring of the melt. The chemical composition thus determined shall be reported to the inspector, and shall conform to the requirements specified in Section 11.

(*b*) The manufacturer shall furnish, on the request of the inspector, drillings taken from the test ingot, for check analysis.

III. PHYSICAL PROPERTIES AND TESTS

Physical Properties

13. The ductility and toughness shall be determined by the drop test.

Drop Test

14. (*a*) The test piece shall be placed head upwards on the supports, and be subjected to the impact of the tup falling free from the following heights:

Weight of Rail, Pounds per Yard	Height of Drop, Feet
45	13
50 to 60	14
61 to 70	15
71 to 80	16
81 to 90	17
91 to 100	18

(*b*) The permanent set after one blow under the drop test shall be recorded.

(*c*) The temperature of the test pieces shall be between 60 and 120 degrees Fahrenheit.

Elongation

15. Under these tests the test piece under one or more blows shall show at least 6 per cent. elongation for one inch, or 5 per cent. each for two consecutive inches of the six-inch scale, marked as described in Section 16.

16. Drop tests shall be made on pieces of rail not less than four feet and not more than six feet long, cut from the top end of the top rail of the ingot. The test pieces shall be marked on the base with gauge marks one inch apart for three inches on each side of the center, for measuring the ductility of the metal.

Drop Testing Machine

17. The drop testing machine used shall be the standard of the American Railway Engineering Association.

(*a*) The tup shall weigh 2,000 pounds, and have a striking face with a radius of 5 inches.

(*b*) The anvil block shall weigh 20,000 pounds and be supported on springs.

STANDARD SPECIFICATIONS FOR ACID BESSEMER STEEL RAILS.—*Continued*

(*c*) The supports for the test pieces shall be a part of, or firmly secured to, the anvil. These supports shall be spaced three feet between centers. The bearing surfaces of the supports shall have a radius of five inches.

Number of Tests

18. One test piece shall be selected from each melt.

(*a*) *First Test.*—If the test piece does not break at the first blow and shows the required elongation on this blow or on successive blows from a height sufficient to develop the ductility, all the rails of the melt represented shall be accepted.

(*b*) If the test piece breaks at the first blow or does not show the required elongation on this blow or on successive blows from a height sufficient to develop the ductility, all the top rails of the melt represented shall be rejected.

(*c*) *Second Test.*—A second test shall then be made of a test piece from the bottom end of any first rail, or from the top end of any second rail of the same melt, preferably of the same ingot. If the test piece does not break at the first blow and shows the required elongation on this blow or on successive blows from a height sufficient to develop the ductility, all of the remainder of the rails of the melt represented shall be accepted.

(*d*) If the test piece breaks at the first blow or does not show the required elongation on this blow or on successive blows from a height sufficient to develop the ductility, all the second rails of the melt represented shall be rejected.

(*e*) *Third Test.*—A third test shall then be made of a test piece from the bottom end of any second rail or from the top end of any third rail of the same melt, preferably of the same ingot. If the test piece does not break at the first blow and shows the required elongation on this blow or on successive blows from a height sufficient to develop the ductility, all of the remainder of the rails of the melt represented shall be accepted.

(*f*) If the test piece breaks at the first blow or does not show the required elongation on this blow or on successive blows from a height sufficient to develop the ductility, all of he remainder of the rails of the melt represented shall be ejected.

STANDARD SPECIFICATIONS FOR ACID BESSEMER STEEL RAILS.—*Continued*

IV. WORKMANSHIP AND FINISH

Weight

19. The weight of the rails specified in the order shall be maintained as nearly as possible, after complying with Section 20. A variation of one-half of one per cent. from the calculated weight of section as applied to an entire order will be allowed.

Section

20. The section of rails shall conform as accurately as possible to the drawing furnished by the purchaser. A variation in height of $\frac{1}{64}$ inch less or $\frac{1}{32}$ inch greater than the specified height, and $\frac{1}{16}$ inch in width of flange, shall be permitted. The template of the splice bar, when inserted in the fishing space of the rail, shall not vary horizontally more than $\frac{1}{16}$ inch from the correct position with reference to the web of the rail. The bearing surfaces under the head and on the top of the flanges shall have the correct inclination.

Straightening

21. (*a*) The hot straightening shall be carefully done, so that gagging under the cold presses will be reduced to a minimum. The distance between the rail supports in the straightening presses shall not be less than 42 inches, except as may be necessary for straightening the rails near the ends. The supports shall have flat surfaces and be out of wind.

(*b*) Rails heard to snap or check while being straightened shall be at once rejected.

Drilling

22. Circular holes for joint bolts shall be drilled according to the drawing and dimensions furnished by the purchaser. A variation of $\frac{1}{32}$ inch in both the size and location of the holes shall be allowed.

Finishing

23. (*a*) All rails shall be smooth on the heads, straight in line and surface, and without any twists, waves, or kinks. They shall be sawed square at the ends, a variation of not more than $\frac{1}{32}$ inch being allowed; and burrs shall be carefully removed.

(*b*) Rails improperly drilled or straightened or from which the burrs have not been removed, shall be rejected, but may be accepted after being properly finished.

(*c*) When any finished rail shows interior defects at either end or in a drilled hole, the entire rail shall be rejected.

STANDARD SPECIFICATIONS FOR ACID BESSEMER STEEL RAILS.—*Continued*

V. MARKING

Marking

24. (*a*) The name of the manufacturer, the weight and type of rail, and the month and year of manufacture shall be rolled in raised letters and figures on the side of the web.

(*b*) For rails weighing 70 pounds per yard and over, the number of the melt and a letter indicating the portion of the ingot from which the rail was made, shall be plainly stamped on the web of the rail where it will not be covered by the splice bars. The top rails shall be lettered A and the succeeding ones B, C, D, etc., consecutively, but in case of a top discard of twenty or more per cent., the letter A will be omitted.

(*c*) For rails weighing less than 70 pounds per yard, the number of the melt shall be plainly stamped on the web of each rail where it will not be covered by the splice bars, and also for testing purposes, on the top three rails of the ingot a letter indicating the portion of the ingot from which the rail was made. The top rails shall be lettered A, and two succeeding ones B and C, respectively.

(*d*) All markings of rails shall be done so effectively that the marks may be read as long as the rails are in service.

VI. INSPECTION

Inspection

25. (*a*) Inspectors representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the rails ordered. The manufacturer shall afford the inspectors, free of cost, all reasonable facilities to satisfy them that the rails are being furnished in accordance with these specifications.

(*b*) All tests and inspections shall be made at the place of manufacture, prior to shipment, and shall be so conducted as not to interfere unnecessarily with the operation of the mill.

(*c*) The manufacturer shall give the purchaser, or his inspector, if so instructed, a reasonable notice, in writing, before rolling shall begin, and similar written notice in advance of each resumption of rolling, in case the order is not filled at one continuous rolling. Should the manufacturer fail to give such notice, all rails rolled during the absence of the authorized representative may be rejected. The party thus notified shall, in turn, give written notice to the manufacturer of his intention to be present, or permission to proceed at the time designated by the manufacturer.

STANDARD SPECIFICATIONS FOR BASIC OPEN HEARTH STEEL RAILS

USED BY THE

CARNEGIE STEEL COMPANY, ILLINOIS STEEL COMPANY
TENNESSEE COAL, IRON AND RAILROAD COMPANY

(For the Metric equivalents of the dimensions and weights given in these specifications, refer to the tables on Pages 13 to 28.)

No. 1 Rails

1. No. 1 classification rails shall be free from injurious defects and flaws of all kinds.

No. 2 Rails

2. (*a*) Rails which by reason of surface imperfections, are not classed as No. 1 rails, will be accepted as No. 2 rails; but rails which have flaws more than ¼ inch in depth, and which contain imperfections in such number or of such character as will, in the judgment of the inspector, make them unfit for recognized No. 2 uses, will not be accepted.

(*b*) No. 2 rails to the extent of five per cent. of the whole order shall be accepted. All rails accepted as No. 2 rails shall have the ends painted white. They shall have two prick punch marks beside the heat number nearest the end of the rail, so placed as not to be covered by the splice bars.

Classes

3. The different classes of rails shall be kept separate.

Payment

4. Rails accepted shall be paid for according to actual weights.

I. MANUFACTURE

Manufacture

5. The entire process of manufacture shall be in accordance with the best current state of the art.

6. Bled ingots shall not be used.

Discard

7. There shall be cut from the end of the bloom and rail, formed from the top of the ingot, sufficient metal to secure sound rails.

Lengths

8. The standard length of the rails shall be 30 feet, or 33 feet, as specified, at a temperature of 60 degrees Fahrenheit. Ten per cent. of the entire order shall be accepted in shorter lengths varying by one foot down to 24 feet. A variation of ¼ inch from the specified lengths shall be allowed, except that for 15 per cent. of the order a variation of ⅜ inch from the specified lengths shall be allowed. Where rails are ordered in lengths greater than standard, proportional variations shall be allowed. Short length No. 1 rails shall be painted green on both ends. If specified in the contract that the

STANDARD SPECIFICATIONS FOR BASIC OPEN HEARTH STEEL RAILS

Continued

rails shall be machined to length cold, a variation of ⅛ inch from the length specified shall be permitted.

Shrinkage

9. (*a*) The number of passes and speed of train shall be so regulated that on leaving the rolls at the final pass, the temperature of the rail shall not exceed that which requires a shrinkage allowance, at the hot saws, of seven inches for a rail 33 feet in length and of 100-pound section, and in the proportion of ⅛ inch less for each ten pound decrease in section, and ⅛ inch more for each ten pound increase in section.

(*b*) The bars shall not be held for the purpose of reducing their temperature, nor shall any artificial means of cooling them be used after they leave the finishing pass. Rails shall be protected from snow and water while on the cooling beds.

Templates

10. Before the general manufacture of the rails is commenced, the manufacturer shall, if required by the engineer (or by the purchaser), supply two sets of templates, internal and external, made of approved material. These templates, engraved as specified in the contract, shall be submitted to the engineer (or the purchaser) for his approval, and at the commencement of the rolling the engineer shall have a competent person present to approve the section.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition

11. The steel shall conform to the following requirements as to chemical composition:

WEIGHT OF RAILS IN POUNDS PER YARD

	45 to 60 Pounds, Per Cent.	61 to 70 Pounds, Per Cent.	71 to 80 Pounds, Per Cent.	81 to 90 Pounds, Per Cent.	91 to 100 Pounds, Per Cent.
Carbon............	.40 to .55	.40 to .55	.45 to .60	.55 to .70	.55 to .70
Manganese.........	.60 to .90	.60 to .90	.60 to .90	.60 to .90	.60 to .90
Silicon, not over....	.20	.20	.20	.20	.20
Phosphorus, not over	.04	.04	.04	.04	.04

NOTE: If desired by the purchaser, an endeavor shall be made to keep the average percentage of carbon in an entire order of rails as high as the mean between the upper and lower limits specified.

Analyses

12. (*a*) An analysis of each melt shall be made by the manufacturer to determine the percentages of carbon, manganese, phosphorus and silicon. This analysis shall be made from a test ingot taken during the pouring of the melt. The chemical composition thus determined shall be

STANDARD SPECIFICATIONS FOR BASIC OPEN HEARTH STEEL RAILS
Continued

reported to the inspector, and shall conform to the requirements specified in Section 11.

(*b*) The manufacturer shall furnish, on the request of the inspector, drillings taken from the test ingot, for check analysis.

III. PHYSICAL PROPERTIES AND TESTS

Physical Properties

13. The ductility and toughness shall be determined by the drop test.

Drop Test

14. (*a*) The test piece shall be placed head upwards on the supports, and be subjected to the impact of the tup falling free from the following heights:

Weight of Rail, Pounds per Yard	Height of Drop, Feet
45	13
50 to 60	14
61 to 70	15
71 to 80	16
81 to 90	17
91 to 100	18

(*b*) The permanent set after one blow under the drop test shall be recorded.

(*c*) The temperature of the test pieces shall be between 60 and 120 degrees Fahrenheit.

Elongation

15. Under these tests the test piece under one or more blows shall show at least 6 per cent. elongation for one inch, or 5 per cent. each for two consecutive inches of the six-inch scale, marked as described in Section 16.

16. Drop tests shall be made on pieces of rail not less than four feet and not more than six feet long, cut from the top end of the top rail of the ingot. The test pieces shall be marked on the base with gauge marks one inch apart for three inches on each side of the center, for measuring the ductility of the metal.

Drop Testing Machine

17. The drop testing machine used shall be the standard of the American Railway Engineering Association.

(*a*) The tup shall weigh 2,000 pounds, and have a striking face with a radius of five inches.

(*b*) The anvil block shall weigh 20,000 pounds and be supported on springs.

(*c*) The supports for the test pieces shall be a part of, or firmly secured to, the anvil. These supports shall b

STANDARD SPECIFICATIONS FOR BASIC OPEN HEARTH STEEL RAILS
Continued

spaced three feet between centers. The bearing surfaces of the supports shall have a radius of five inches.

Number of Tests

18. Test pieces shall be selected from the second, middle, and last full ingot of each melt.

(*a*) *First Test.*—If two of these test pieces do not break at the first blow and show the required elongation on this blow or on successive blows from a height sufficient to develop the ductility, all the rails of the melt represented shall be accepted.

(*b*) If two of these test pieces break at the first blow or do not show the required elongation on this blow or on successive blows from a height sufficient to develop the ductility, all the top rails of the melt represented shall be rejected.

(*c*) *Second Test.*—A second set of three test pieces shall then be selected from the bottom end of any first rails, or from the top end of any second rails of the same melt, preferably of the same ingots. If two of these test pieces do not break at the first blow and show the required elongation on this blow or on successive blows from a height sufficient to develop the ductility, all of the remainder of the rails of the melt represented shall be accepted.

(*d*) If two of these test pieces break at the first blow or do not show the required elongation on this blow or on successive blows from a height sufficient to develop the ductility, all the second rails of the melt represented shall be rejected.

(*e*) *Third Test.*—A third set of three test pieces shall then be selected from the bottom end of any second rails or from the top end of any third rails of the same melt, preferably of the same ingots. If two of these test pieces do not break at the first blow and show the required elongation on this blow or on successive blows from a height sufficient to develop the ductility, all of the remainder of the rails of the melt represented shall be accepted.

(*f*) If two of these test pieces break at the first blow or do not show the required elongation on this blow or on successive blows from a height sufficient to develop the ductility, all of the remainder of the rails of the melt represented shall be rejected.

STANDARD SPECIFICATIONS FOR BASIC OPEN HEARTH STEEL RAILS
Continued

IV. WORKMANSHIP AND FINISH

Weight

19. The weight of the rails specified in the order shall be maintained as nearly as possible, after complying with Section 20. A variation of one-half of one per cent. from the calculated weight of section as applied to an entire order will be allowed.

Section

20. The section of rails shall conform as accurately as possible to the drawing furnished by the purchaser. A variation in height of $\frac{1}{64}$ inch less or $\frac{1}{32}$ inch greater than the specified height, and $\frac{1}{16}$ inch in width of flange, shall be permitted. The template of the splice bar, when inserted in the fishing space of the rail, shall not vary horizontally more than $\frac{1}{16}$ inch from the correct position with reference to the web of the rail. The bearing surfaces under the head and on the top of the flanges shall have the correct inclination.

Straightening

21. (*a*) The hot straightening shall be carefully done, so that gagging under the cold presses will be reduced to a minimum. The distance between the rail supports in the straightening presses shall not be less than 42 inches, except as may be necessary for straightening the rails near the ends. The supports shall have flat surfaces and be out of wind.

(*b*) Rails heard to snap or check while being straightened shall be at once rejected.

Drilling

22. Circular holes for joint bolts shall be drilled according to the drawing and dimensions furnished by the purchaser. A variation of $\frac{1}{32}$ inch in both the size and location of the holes shall be allowed.

Finishing

23. (*a*) All rails shall be smooth on the heads, straight in line and surface, and without any twists, waves, or kinks. They shall be sawed square at the ends, a variation of not more than $\frac{1}{32}$ inch being allowed; and burrs shall be carefully removed.

(*b*) Rails improperly drilled or straightened or from which the burrs have not been removed, shall be rejected, but may be accepted after being properly finished.

(*c*) When any finished rail shows interior defects at either end or in a drilled hole, the entire rail shall be rejected.

V. MARKING

Marking

24. (*a*) The name of the manufacturer, the weight and type of rail, and the month and year of manufacture shall be rolled in raised letters and figures on the side of the web.

STANDARD SPECIFICATIONS FOR BASIC OPEN HEARTH STEEL RAILS
Continued

(*b*) For rails weighing 70 pounds per yard and over, the umber of the melt and a letter indicating the portion of the got from which the rail was made, shall be plainly stamped n the web of the rail where it will not be covered by the splice ars. The top rails shall be lettered A and the succeeding nes B, C, D, etc., consecutively, but in case of a top discard f twenty or more per cent., the letter A will be omitted.

(*c*) For rails weighing less than 70 pounds per yard, the umber of the melt shall be plainly stamped on the web of ach rail where it will not be covered by the splice bars, and lso for testing purposes, on the top three rails of the ingot a etter indicating the portion of the ingot from which the rail was made. The top rails shall be lettered A, and two succeeding ones B and C, respectively.

(*d*) All rails shall be branded or stamped "O. H." All markings of rails shall be done so effectively that the marks may be read as long as the rails are in service.

VI. INSPECTION

25. (*a*) Inspectors representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the rails ordered. The manufacturer shall afford the inspectors, free of cost, all reasonable facilities to satisfy them that the rails are being furnished in accordance with these specifications.

Inspection

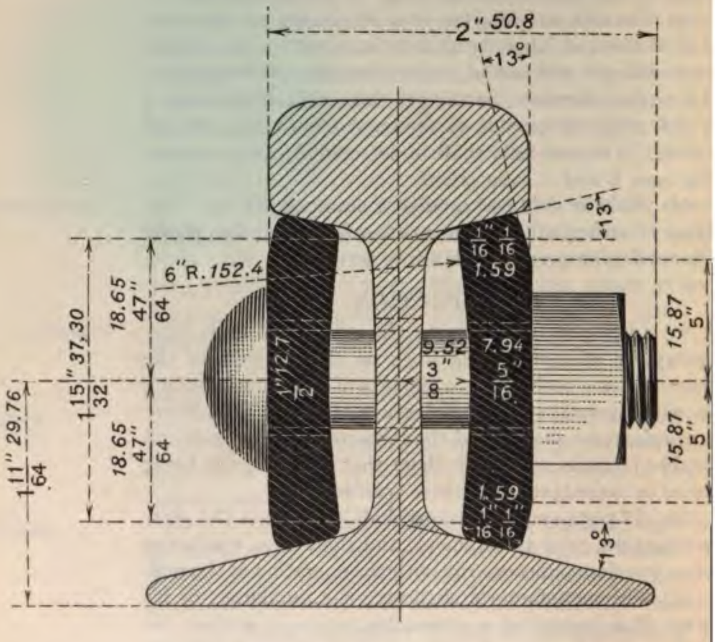
(*b*) All tests and inspections shall be made at the place of manufacture, prior to shipment, and shall be so conducted as not to interfere unnecessarily with the operation of the mill.

(*c*) The manufacturer shall give the purchaser, or his nspector, if so instructed, a reasonable notice, in writing, before rolling shall begin, and similar written notice in advance of each resumption of rolling, in case the order is not filled at one continuous rolling. Should the manufacturer fail to give such notice, all rails rolled during the absence of the authorized epresentative may be rejected. The party thus notified shall, in turn, give written notice to the manufacturer of his ntention to be present, or permission to proceed at the time designated by the manufacturer.

STEEL RAILS AND ACCESSORIES

Standard American Types of Splice Bars for Tee Rails

FISH BAR

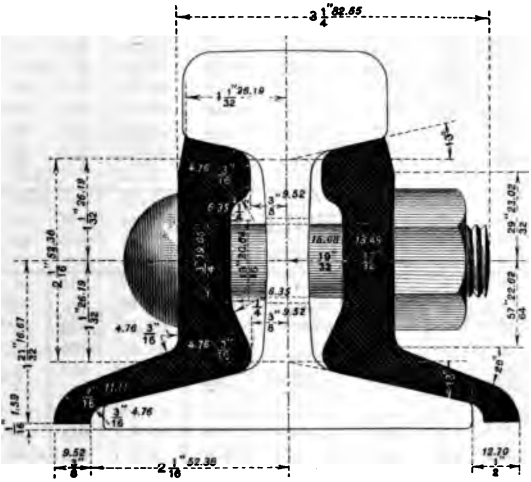


Above illustration represents Fish Bar Section No. S-2040 for Rails weig 20 lbs. per yard (9.92 kilos per meter). For particulars of lengths, weig etc., of Fish Bars see table on page 330.

STEEL RAILS AND ACCESSORIES

Standard American Types of Splice Bars for Tee Rails

ANGLE SPLICE BAR



Above illustration represents Angle Bar Section No. S-5040 for Rails weighing 50 lbs. per yard (24.80 kilos per meter). For lengths, weights, etc., of Angle Bars see table on pages 330 to 332.

SPLICE BARS AND ACCESSORIES

For the foregoing Standard Sections of Tee Rails

FISH BARS

(See illustration page 328)

Splice Bar Section	Length of Splice Bars		Weight of One Pair of Splice Bars		Weight of Bolts and Nuts For One Joint		Number of Bolts	Total Weight of One Joint	
	Inches	m/m	Lbs.	Kilos	Lbs.	Kilos		Lbs.	Kilos
S 840	$16\frac{1}{8}$	410	2.00	0.91	0.45	0.20	4	2.45	1.11
S1040	$16\frac{1}{8}$	410	2.60	1.18	0.45	0.20	4	3.05	1.38
S1240	$16\frac{1}{8}$	410	3.44	1.56	0.80	0.36	4	4.24	1.92
S1440	$16\frac{1}{8}$	410	3.44	1.56	0.80	0.36	4	4.24	1.92
S1640	$16\frac{1}{8}$	410	4.36	1.98	0.80	0.36	4	5.16	2.34
S2040	$16\frac{1}{8}$	410	4.86	2.20	0.83	0.38	4	5.69	2.58
S20.2-86	$10\frac{1}{32}$	255	3.40	1.54	1.76	0.80	4	5.16	2.34
S2486	$16\frac{1}{8}$	410	5.90	2.68	1.60	0.73	4	7.50	3.40
S2540	$16\frac{1}{8}$	410	5.70	2.58	0.86	0.39	4	6.56	2.97
S3040A	$16\frac{1}{8}$	410	7.41	3.36	1.58	0.72	4	8.99	4.08
S3540A	$16\frac{1}{8}$	410	7.68	3.49	1.58	0.72	4	9.26	4.21
S4040A	20	508	11.61	5.26	2.72	1.24	4	14.33	6.50
S40.3-75 S40.3-75A	$14\frac{3}{16}$	360	11.06	5.02	2.00	0.91	4	13.06	5.93
S4275	20	508	14.72	6.68	2.64	1.20	4	17.36	7.88
S4540A	20	508	13.87	6.29	2.84	1.29	4	16.71	7.58
S5040B	19	483	15.38	6.98	2.98	1.35	4	18.36	8.33

ANGLE BARS

(See illustration page 329)

Splice Bar Section	Length of Splice Bars		Weight of One Pair of Splice Bars		Weight of Bolts and Nuts For One Joint		Number of Bolts	Total Weight of One Joint	
	Inches	m/m	Lbs.	Kilos	Lbs.	Kilos		Lbs.	Kilos
S27.9-86	$16\frac{1}{8}$	410	10.00	4.54	1.54	0.70	4	11.54	5.24
S3040	$16\frac{1}{8}$	410	10.45	4.74	1.60	0.73	4	12.05	5.47
S30.5-77	$14\frac{3}{16}$	360	11.91	5.40	1.60	0.73	4	13.51	6.13
S3540	$16\frac{1}{8}$	410	12.10	5.50	1.60	0.73	4	13.70	6.23
S4040	20	508	16.10	7.30	2.66	1.21	4	18.76	8.51
S4075	$18\frac{3}{32}$	460	15.29	6.94	1.48	0.67	4	16.77	7.61
S4540	20	508	18.75	8.50	2.72	1.23	4	21.47	9.73
S46.4-75	$24\frac{13}{32}$	620	27.66	12.55	4.60	2.09	6	32.26	14.64
S5040	24	610	25.50	11.60	2.78	1.26	4	28.28	12.86
S5090	31	787	37.80	17.15	4.54	2.06	6	42.34	19.21
S50.4-77	$21\frac{15}{32}$	545	25.87	11.73	3.17	1.44	4	29.04	13.17
S51.4-77	$24\frac{13}{16}$	630	35.84	16.26	4.24	1.92	6	40.08	18.18
S54.4-77	16	406	29.70	13.47	3.32	1.51	4	33.02	14.98
S5540	24	610	28.90	13.10	2.91	1.32	4	31.81	14.42

SPLICE BARS AND ACCESSORIES FOR TEE RAILS.—*Continued*

ANGLE BARS.—*Continued*

Splice Bar Section	Length of Splice Bars		Weight of One Pair of Splice Bars		Weight of Bolts and Nuts For One Joint		Number of Bolts	Total Weight of One Joint	
	Inches	m/m	Lbs.	Kilos	Lbs.	Kilos		Lbs.	Kilos
S5540 A	24	610	34.66	15.72	3.01	1.37	4	37.67	17.09
S6040	24	610	32.40	14.70	2.93	1.33	4	35.33	16.03
S6020	24	610	40.92	18.56	2.98	1.35	4	43.90	19.91
S6030	24	610	36.24	16.44	2.98	1.35	4	39.22	17.79
S6078	24	610	36.40	16.50	2.93	1.33	4	39.33	17.83
S60.5–75	$25\frac{31}{32}$	660	42.16	19.12	6.96	3.16	6	49.12	22.28
S60.5–77	20	508	26.80	12.15	3.42	1.55	4	30.22	13.70
S6275	$29\frac{11}{16}$	754	44.74	20.29	....	....	6	....	....
S6540	24	610	35.55	16.10	2.98	1.35	4	38.53	17.45
S67.5–75	$31\frac{1}{32}$	788	60.80	27.58	....	....	6	....	....
S67.5–75 A	24	610	46.80	21.23	4.52	2.05	4	51.32	23.28
S6540	24	610	35.55	16.10	2.98	1.35	4	38.53	17.45
S7040	34	864	54.64	24.78	4.56	2.07	6	59.20	26.85
S7040 A	34	864	61.90	28.08	4.56	2.07	6	66.46	30.15
S7040 B	$29\frac{29}{32}$	760	60.50	27.44	6.18	2.80	6	66.68	30.24
S7040 C	$29\frac{29}{32}$	760	46.74	21.20	6.69	3.03	6	53.43	24.23
S7020	34	864	63.73	28.91	4.56	2.07	6	68.29	30.98
S7030	34	864	64.72	29.36	4.72	2.14	6	69.44	31.50
S7033	34	864	53.25	24.15	4.56	2.07	6	57.81	26.22
S7033 A	34	864	54.64	24.78	4.72	2.14	6	59.36	26.92
S7033 B	24	610	35.64	16.17	3.04	1.38	4	38.68	17.55
S7250	34	864	51.96	23.09	4.24	1.92	6	56.20	25.01
S72.8–75	25	635	45.54	20.66	4.26	1.93	4	49.80	22.59
S7540	34	864	57.97	26.30	6.74	3.06	6	64.71	29.36
S7540 A	34	864	63.13	28.64	7.02	3.18	6	70.15	31.82
S7550	34	864	59.89	27.17	6.74	3.06	6	66.63	30.23
S7524	34	864	65.69	29.80	6.67	3.03	6	72.36	32.83
S7522	34	864	62.50	28.35	4.63	2.10	6	67.13	30.45
S7577	32	813	68.03	30.86	7.25	3.29	6	75.28	34.15
S7578	22	559	44.76	20.30	4.56	2.07	4	49.32	22.37
S77.6–77	$28\frac{11}{32}$	720	54.11	24.54	7.55	3.42	6	61.66	27.96
S8040	34	864	62.58	28.39	6.90	3.13	6	69.48	31.52
S8040 A	34	864	66.25	30.05	6.90	3.13	6	73.15	33.18
S8040 B	34	864	67.61	30.67	7.14	3.24	6	74.75	33.91
S8040 C	26	660	45.52	20.65	4.98	2.26	4	76.80	34.84
S8010	24	610	43.94	19.93	5.29	2.40	4	49.23	22.33
S8020	34	864	73.22	33.21	6.87	3.12	6	80.09	36.33
S8020 A	34	864	63.58	28.84	6.90	3.13	6	70.48	31.97
S8030	34	864	68.42	31.04	7.01	3.18	6	75.43	34.22
S8022	36	914	67.72	30.71	6.02	2.73	6	73.74	33.44
S8077	32	813	64.86	29.42	4.88	2.21	6	69.74	31.63

SPLICE BARS AND ACCESSORIES FOR TEE RAILS.—*Continued*

ANGLE BARS.—*Continued*

Splice Bar Section	Length of Splice Bars		Weight of One Pair of Splice Bars		Weight of Bolts and Nuts For One Joint		Number of Bolts	Total Wei of One Jo	
	Inches	m/m	Lbs.	Kilos	Lbs.	Kilos		Lbs.	K
S8078 S8078 A	30	762	84.00	38.10	9.52	4.32	6	93.52	4
S8079	31	787	56.88	25.80	7.08	3.21	6	63.96	2
S80.2-77	26½	673	50.88	23.08	7.02	3.18	6	57.90	2
S8540	34	864	67.56	30.65	6.90	3.13	6	74.46	3
S8550	26	660	48.46	21.98	5.32	2.41	4	53.78	2
S8550 A	34	864	68.57	31.10	6.86	3.11	6	75.43	3
S8520	22	559	45.60	20.68	4.88	2.21	4	50.48	2
S8521	24	610	53.50	24.27	6.78	3.08	4	60.28	2
S8531	26½	673	60.30	27.35	5.06	2.29	4	65.36	2
S8524	26	660	54.32	24.64	6.10	2.77	4	60.42	2
S8575	33	838	67.34	30.55	8.33	3.78	6	75.67	3
S88.5-77	26½	673	51.46	23.34	7.02	3.18	6	58.48	2
S9040	34	864	72.74	32.99	9.40	4.26	6	82.14	3
S9020	34	864	90.51	41.06	9.52	4.32	6	100.03	4
S9030	34	864	77.53	35.17	9.70	4.40	6	87.23	3
S9034	24	610	59.90	27.17	7.02	3.18	4	66.92	3
S9023	34	864	78.33	35.53	9.70	4.40	6	88.03	3
S9133	30	762	65.31	29.62	9.87	4.48	6	75.18	3
S10040	34	864	85.65	38.85	9.70	4.40	6	95.35	4
S10040 A	34	864	91.96	41.71	10.09	4.58	6	102.05	4
S10020	34	864	103.94	46.15	9.70	4.40	6	113.64	5
S10030	34	864	91.62	41.56	9.70	4.40	6	101.32	4
S10030 B	26	660	73.93	33.53	7.55	3.43	4	81.48	3
S10034	24	610	62.40	28.30	5.46	2.48	4	67.86	3
S10032	28	711	62.75	28.46	8.07	3.66	6	70.82	3
S10077	33	838	82.78	37.55	8.21	3.72	6	90.99	4
S10078 S10078-A	30	762	108.10	49.03	9.52	4.32	6	117.62	5
S10079	31	787	79.40	35.02	10.00	4.54	6	89.40	4
S11033 S11033-A	26	660	84.00	38.10	10.50	4.76	6	94.50	4

NOTE.—The weights given in the foregoing table are approximate an guaranteed; the weights actually shipped will be charged for in all cases

STANDARD SPECIFICATIONS FOR STEEL SPLICE BARS

(For the Metric equivalents of the dimensions and weights given in these specifications, refer to the tables on pages 13 to 28.)

I. MANUFACTURE

Process

1. The steel may be made by the acid Bessemer or basic Open Hearth (Siemens-Martin) process.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition

2. The steel shall conform to the following requirements as to chemical composition.

Phosphorus { Bessemer......not over 0.115 per cent.
Phosphorus { Open Hearth...not over 0.05 per cent.

Ladle Analyses

3. For Bessemer steel an analysis of each melt shall be made by the manufacturer to determine the percentage of carbon, and an analysis every twelve hours, representing each day and night turn, to determine the average percentages of carbon, manganese, phosphorus and sulphur. For open-hearth steel an analysis of each melt shall be made by the manufacturer to determine the percentages of carbon, manganese, phosphorus and sulphur. These analyses shall be made from a test ingot taken during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, and shall conform to the requirements specified in Section 2.

Check Analyses

4. An analysis may be made by the purchaser from a finished splice bar representing each melt. The phosphorus content thus determined shall not exceed that specified in Section 2 by more than 25 per cent.

III. PHYSICAL PROPERTIES AND TESTS

Tension Tests

5. (*a*) The splice bars shall conform to the following requirements as to tensile properties:

Tensile strength, lbs. per sq. in....... (See Section 5*b*)	55,000–65,000
Elongation in 8 in., min. per cent....	$\frac{1,500,000}{\text{Tens. Str.}}$

(*b*) The tensile strength may be over 65,000 to and including 68,000 pounds per square inch, provided the elongation in 8 inches is not less than 23 per cent.

STANDARD SPECIFICATIONS FOR STEEL SPLICE BARS.—*Continued*

Bend Tests

6. The test specimen shall bend cold through 180 degrees flat on itself without cracking on the outside of the bent portion.

Test Specimens

7. Tension and bend test specimens shall be taken from finished rolled bars. Tension test specimens shall be of 8 inch gauge length. Bend tests may be made of an unpunched splice bar, flattened if necessary.

Number of Tests

8. (*a*) One tension and one bend test shall be made from each melt.

(*b*) If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

(*c*) If the percentage of elongation of any tension test specimen is less than that specified in Section 5 and any part of the fracture is outside the middle third of the gauge length, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

IV. WORKMANSHIP AND FINISH

Workmanship

9. The splice bars shall be smoothly rolled, true to tem plate, and shall accurately fit the rails for which they ar intended. The bars shall be sheared to length, and th punching and notching shall conform to the dimensions spec fied by the purchaser. A variation of $\frac{1}{32}$ inch from the spec fied size and location of holes, and of ⅛ inch from the specifie length of splice bar, will be permitted. Any variation from straight line in a vertical plane shall be such as will make th bars high in the center. The maximum camber in either plan shall not exceed $\frac{1}{16}$ inch in 24 inches.

Finish

10. The finished splice bars shall be free from injurious de fects and shall have a workmanlike finish.

V. MARKING

Marking

11. The name or brand of the manufacturer and the yea of manufacture shall be rolled in raised letters and figures o the side of the rolled bars, and a portion of this marking shal appear on each finished splice bar.

STANDARD SPECIFICATIONS FOR STEEL SPLICE BARS.—*Continued*

VI. INSPECTION

12. The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the splice bars ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the splice bars are being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works. Inspectio

DUQUESNE RAIL JOINT

Reinforced rail joints have come into such general use that it is h
necessary to set up any special arguments in their favor, but for those
have not given the question any serious consideration we might point
few reasons for using the Duquesne rail joint.

While the standard angle bar holds the rails in very satisfactory shap
a few years, it is found that battered rail ends occur frequently. The use o
Duquesne rail joint has practically eliminated this annoyance. When
considered that a very large investment is made in rails, it is true econom
make a little additional expenditure for the joint, in order to get a gr
life from the rail.

The use of the Duquesne rail joint is especially advantageous on Ele
railways. An important consideration is the solid joint secured. Loose j
result in lost efficiency in the bonding.

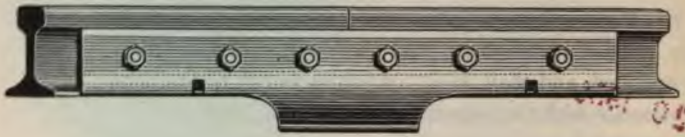
We make no special recommendations as to the length of the joint,
leave this to the decision of the railway engineers. We believe, however,
a four-hole joint under moderately heavy traffic is in most cases satisfac
although on heavy trunk lines, with many curves, it has been found adva
geous to use a longer joint with six bolts.

The Duquesne joint is rolled as shown on our cross-sectional plans, and
be cut to any length and punched to suit any details.

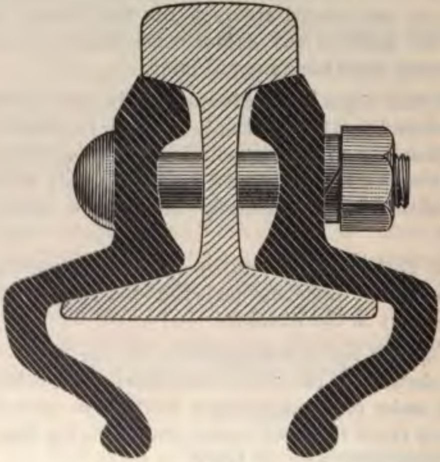
Duquesne Rail Joint.—*Continued*

In manufacturing the Duquesne rail joint, our practice is either to anneal properly all bars that are shaped, punched and slotted while cold; or to do this work while they are hot. We find it important to hot work all bars .30 carbon or over. We are equipped to oil-temper the bars to meet certain demands, but experience has shown that this treatment has very little effect on low carbon steel, and we would recommend it only where the higher carbons are used.

We are prepared to furnish the Duquesne rail joint for any standard rail, and to any consistent specification.



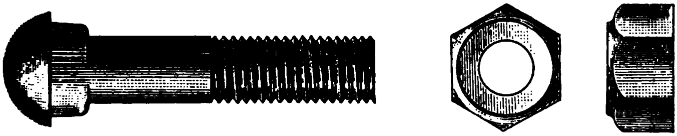
Elevation



Cross Section
As applied to A. S. C. E. Standard Rail

TRACK BOLTS

(Manufactured by Illinois Steel Company)



Furnished with Rolled, Cut or Harvey Grip Rolled Threads, and with Hexagon or Square nuts. Square nuts, Ideal Recessed, are largely used with Harvey Grip Threads, and may be so furnished if desired.

Diameter		Length		Average Number per Keg of 200 Lbs. (90.72 Kilos)				
				Rolled Thread		Cut Thread		Harvey Grip
Inches	m/m	Inches	m/m	With Square Nuts	With Hexagon Nuts	With Square Nuts	With Hexagon Nuts	Ideal Recessed
⅜	9.5	1½	38	2115	2170	...	...	...
⅜	9.5	1¾	44	2000	2050	...	...	...
⅜	9.5	2	51	1895	1940	...	...	...
½	12.7	1¾	44	1012	1064	914	976	...
½	12.7	2	51	964	1006	860	914	...
½	12.7	2¼	57	915	953	812	860	...
½	12.7	2½	64	875	914	763	812	...
⅝	15.9	2½	64	505	533	457	476	457
⅝	15.9	2¾	70	483	506	435	452	435
⅝	15.9	3	76	462	484	416	431	416
¾	19	3	76	278	294	271	278	262
¾	19	3¼	83	269	283	260	268	256
¾	19	3½	90	259	273	250	258	250
¾	19	3¾	95	250	263	240	247	244
¾	19	4	102	242	254	231	238	236
¾	19	4¼	108	235	246	223	230	231
13/16	20.6	3½	90	230	242	...	...	220
13/16	20.6	3¾	95	221	232	...	...	211
13/16	20.6	4	102	212	222	...	...	203
13/16	20.6	4¼	108	204	214	...	...	196
13/16	20.6	4½	114	197	206	...	...	189

TRACK BOLTS.—*Continued*

Diameter		Length		Average Number per Keg of 200 Lbs. (90.72 Kilos)				
				Rolled Thread		Cut Thread		Harvey Gri
Inches	m/m	Inches	m/m	With Square Nuts	With Hexagon Nuts	With Square Nuts	With Hexagon Nuts	Ideal Recessed
7/8	22.2	4	102	170	178	162	170	159
7/8	22.2	4¼	108	164	171	156	164	154
7/8	22.2	4½	114	159	166	151	158	148
7/8	22.2	4¾	121	154	161	146	153	144
7/8	22.2	5	127	149	156	142	148	139
15/16	23.8	4	102	152	160	...	...	141
15/16	23.8	4¼	108	147	156	...	...	136
15/16	23.8	4½	114	142	151	...	...	132
15/16	23.8	4¾	121	138	146	...	...	129
15/16	23.8	5	127	134	141	...	...	125
1	25.4	4½	114	120	126	117	112	114
1	25.4	4¾	121	116	121	113	108	111
1	25.4	5	127	113	117	109	105	108
1	25.4	5¼	133	109	114	106	102	105
1	25.4	5½	140	106	111	103	99	102
1	25.4	5¾	146	104	108	100	97	100
1 1/16	27	4½	114	112	119	...	...	106
1 1/16	27	4¾	121	108	114	...	...	102
1 1/16	27	5	127	105	110	...	...	99
1 1/16	27	5¼	133	102	107	...	...	96
1 1/16	27	5½	140	99	104	...	...	94
1 1/16	27	5¾	146	96	101	...	...	91
1 1/16	27	6	152	94	98	...	...	89

Sizes other than those mentioned above can be supplied.

Diameters given above are the diameters at the threads. Bolts with rolle threads have slightly smaller diameters at the shank than at the threads.

STANDARD SPECIFICATIONS FOR STEEL TRACK BOLTS AND NUTS

(For the Metric equivalents of the dimensions and weights given in these specifications, refer o the tables on Pages 13 to 28.)

I. MANUFACTURE

Process

1. The steel may be made by the acid Bessemer or basic Open Hearth (Siemens-Martin) process.

II. PHYSICAL PROPERTIES AND TESTS

Tension Tests

2. Test specimens cut from full sized bars from which the bolts are made or a test specimen ½ inch by 2 inches turned from a finished bolt, shall conform to the following tensile properties:

Tensile strength, pounds per square inch. . 55,000 to 70,000
Elongation in 2 in., minimum per cent...... 25

Tests of Finished Bolts and Nuts

3. Nuts must be made of a good tough quality of steel. The finished bolts must stand the following:

Bend Tests of Unthreaded Bolt: The bolt shall bend cold through 180 degrees flat on itself without cracking on the outside of the bent portion.

Stripping Test: The thread equal in length to the thickness of the nut shall withstand the destruction of the bolt before stripping.

Head Test: Heads shall stand bending backwards to show that they are firmly joined to body of bolt.

III. WORKMANSHIP AND FINISH

Workmanship

4. The bolts and nuts shall conform to the dimensions specified by the purchaser. The bolts shall be neatly formed, free from fins or nickings. The head shall be concentric with, and firmly joined to, the body of the bolt, with the under side of the head at right angles to the body of the bolt. The threads shall be sharp and true to gauge and of the pattern specified by the purchaser. The nuts shall fit the bolts tightly so as to require a wrench not more than 10 inches in length to turn them down without distorting the threads or twisting the bolts. The nuts shall be screwed on before shipping, a sufficient number of turns to hold them on to destination. A variation of $\frac{1}{32}$ inch under and $\frac{1}{64}$ inch over the

STANDARD SPECIFICATIONS FOR STEEL TRACK BOLTS AND NUTS.—*Con*

specified diameter of the body of the bolt will be perm
The diameter of the rolled thread shall not exceed the
eter of the body of the bolt more than $\frac{1}{16}$ inch for $\frac{7}{8}$ inch
and $\frac{3}{32}$ inch for one inch bolts. A variation in the dime
of the elliptical shoulders under the head of the bolt of
from the specified size will be permitted. A taper of the
der of $\frac{1}{32}$ inch will be permitted. The length of the bolt
the head shall not vary more than $\frac{1}{8}$ inch from that spe

Finish

5. The finished bolts and nuts shall be free from inj
defects and shall have a workmanlike finish.

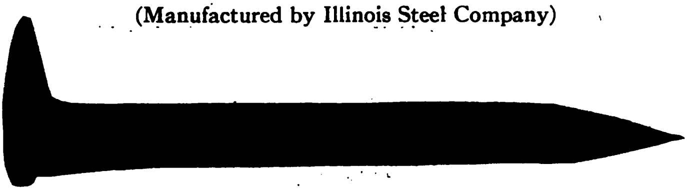
IV. INSPECTION

Inspection

6. The inspector representing the purchaser shall hav
entry, at all times while work on the contract of the purc
is being performed, to all parts of the manufacturer's
which concern the manufacture of the track bolts and
ordered. The manufacturer shall afford the inspector f
cost, all reasonable facilities to satisfy him that the
bolts and nuts are being furnished in accordance with
specifications. All tests and inspection shall be made a
place of manufacture prior to shipment, unless othe
specified, and shall be so conducted as not to interfere unr
sarily with the operation of the works.

RAILROAD SPIKES

(Manufactured by Illinois Steel Company)

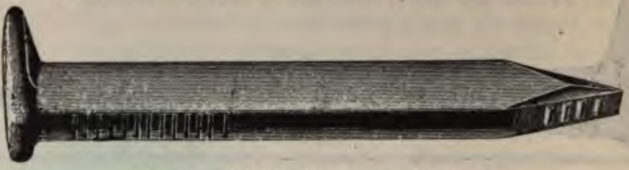


Size Measured under Head		Used with Rails Weighing*		Average Number of Spikes per Keg of 200 Lbs. (90.72 Kilos). Estimated, Not Guaranteed
Inches	m/m	Lbs. per Yard	Kilos per Meter	
6½x⅝	165x15.9	....	....	243
6 x⅝	152x15.9	....	....	269
6 x9/16	152x14.3	....	....	309
5½x9/16	140x14.3	45 to 110	22.32 to 54.56	340
5 x9/16	127x14.3	40	19.84	360
5 x½	127x12.7	40	19.84	490
4½x9/16	114x14.3	....	....	385
4½x½	114x12.7	35	17.36	536
4½x7/16	114x11.1	....	....	690
4½x⅜	114x 9.5	....	....	920
4 x½	102x12.7	25 and 30	12.4 and 14.88	600
4 x7/16	102x11.1	25 and 30	12.4 and 14.88	684
4 x⅜	102x 9.5	....	....	1015
3½x½	89x12.7	20	9.92	620
3½x7/16	89x11.1	....	....	830
3½x⅜	89x 9.5	16	7.94	1170
3½x5/16	89x 7.9	....	....	1675
3 x½	76x12.7	....	....	700
3 x⅜	76x 9.5	12 and 14	5.95 and 6.94	1340
3 x5/16	76x 7.9	....	....	1900
2½x⅜	64x 9.5	8 and 10	3.97 and 4.96	1520
2½x5/16	64x 7.9	8 and 10	3.97 and 4.96	2200
2 x5/16	51x 7.9	....	....	2610

*The Spikes for rails shown in this column are the standard sizes of spikes for these rails. Other sizes can be furnished when required, but they are special and cannot be supplied as promptly.

RAILROAD SPIKES WITH HOOK HEADS

(Manufactured by American Steel & Wire Company)

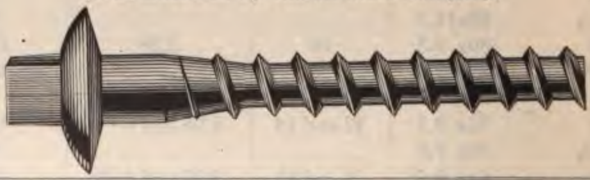


(Also furnished with reversed points)

Size Measured under Head		Used with Rails Weighing		Average Numbe of Spikes per Keg of 200 L (90.72 Kilos). Estimated, Not Guarantee
Inches	m/m	Lbs. per Yard	Kilos per Meter	
5 x½	127x12.7	35 to 40	17.36 to 19.84	450
4½x½	114x12.7	28 to 35	13.89 to 17.36	530
4 x½	102x12.7	24 to 35	11.90 to 17.36	600
4½x$\frac{7}{16}$	114x11.1	20 to 30	9.92 to 14.88	680
4 x$\frac{7}{16}$	102x11.1	20 to 30	9.92 to 14.88	720
3½x$\frac{7}{16}$	89x11.1	16 to 25	7.94 to 12.40	900
4 x⅜	102x 9.5	16 to 25	7.94 to 12.40	1000
3½x⅜	89x 9.5	16 to 20	7.94 to 9.92	1190
3 x⅜	76x 9.5	16 to 20	7.94 to 9.92	1240
2½x⅜	64x 9.5	12 to 16	5.95 to 7.94	1342
2½x$\frac{5}{16}$	64x 8	8 and 10	3.97 and 4.96	2332

RAILROAD SCREW SPIKES

(Manufactured by Illinois Steel Company)



Size Measured under Head		Average Number per Keg	
Inches	m/m	150 Lbs. (68.04 Kilos)	200 Lbs. (90.72 Kilo
6 x⅞	152x22.2	128	176
5½x¾	140x19.1	189	252

Other sizes can be made to order

STANDARD SPECIFICATIONS FOR STEEL RAILWAY SPIKES

(For the Metric equivalents of the dimensions and weights given in these specifications, refer to the tables on Pages 13 to 28.)

I. MANUFACTURE

Process

1. The steel may be made by the acid Bessemer or basic Open Hearth (Siemens-Martin) process.

II. PHYSICAL PROPERTIES AND TESTS

Tension Tests

2. The full-size finished spikes, or the full-size bars from which the spikes are made shall conform to the following tensile properties:

Tensile strength, pounds per square inch. . 55,000 to 70,000
Elongation in 2 in., minimum per cent. 25

Bend Tests

3. The test specimen shall bend cold through 180 degrees flat on itself without cracking on the outside of the bent portion.

Tests of Finished Spikes

4. The finished spike must stand the following:

Head Test.—The head shall be flattened in the direction of length of spike by blows of hammer without fracture.

Driving Test.—A spike shall withstand being driven home to the rail in a white oak tie without sign of fracture.

III. WORKMANSHIP AND FINISH

Workmanship

5. The spikes shall conform to the dimensions specified by the purchaser. A variation of $\frac{1}{64}$ inch under the specified dimension of the body of the spike, measured from the face to the back, and a variation of $\frac{1}{32}$ inch over the specified dimension of the body of the spike, measured across the face, will be permitted. A variation of $\frac{3}{32}$ inch over and $\frac{1}{32}$ inch under the specified dimensions of the head of the spike will be permitted. A variation of $\frac{1}{8}$ inch from the specified length of the spike, measured from the under side of the head to the point, will be permitted. A variation of one degree in the specified angle of the under side of the head of the spike will be permitted.

STANDARD SPECIFICATIONS FOR STEEL RAILWAY SPIKES.—*Continued*

Finish 6. The finished spikes shall be free from injurious defec and shall have a workmanlike finish.

IV. INSPECTION

Inspection 7. The inspector representing the purchaser shall ha free entry, at all times while work on the contract of the pu chaser is being performed, to all parts of the manufacture works which concern the manufacture of the railroad spik ordered. The manufacturer shall afford the inspector, fr of cost, all reasonable facilities to satisfy him that the railro spikes are being furnished in accordance with these specific tions. All tests and inspection shall be made at the place manufacture prior to shipment, unless otherwise specifie and shall be so conducted as not to interfere unnecessari with the operation of the works.

STANDARD SPECIFICATIONS FOR STEEL TIE PLATES

(For the Metric equivalents of the dimensions and weights given in these specifications, ref to the tables on Pages 13 to 28.)

I. MANUFACTURE

Process 1. The steel may be made by the acid Bessemer or basi Open Hearth (Siemens-Martin) process.

II. PHYSICAL PROPERTIES AND TESTS

Tension Tests 2. The tie plates shall conform to the following require ments as to tensile properties:

Tensile strength, pounds per square inch . . . 55,000 to 70,00
Elongation in 2 in., minimum per cent 25

Bend Tests 3. The test specimen shall bend cold through 180 degree flat on itself without cracking on the outside of the ben portion.

III. WORKMANSHIP AND FINISH

Workmanship 4. The tie plates shall be smoothly rolled, true to template and shall be straight and out of wind on the surface which wil form the bearing for the rail. They shall be sheared to the length and punched to the dimensions specified by the pur- chaser, with the following permissible variations:

STANDARD SPECIFICATIONS FOR STEEL TIE PLATES.—*Continued*

(*a*) For plates with shoulders parallel to the direction of rolling, a variation of $\frac{1}{32}$ inch in thickness, $\frac{1}{8}$ inch in rolled width and $\frac{3}{16}$ inch in sheared length will be permitted.

(*b*) For plates with shoulders perpendicular to the direction of rolling, a variation of $\frac{1}{32}$ inch in thickness, $\frac{1}{8}$ inch in rolled width and $\frac{1}{4}$ inch in sheared length will be permitted.

Finish

5. The finished tie plates shall be free from burrs and other urface deformations caused by the shearing and punching; hey shall also be free from other injurious defects and shall ave a workmanlike finish.

IV. INSPECTION

Inspection

6. The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the tie plates ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the tie plates are being furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

STEEL CROSS TIES

We show on the following pages sections of various Steel Cross Ties covering requirements for all kinds of railway work, from heavy steam railways to light mining and plantation railways.

Many of the heavy sections are in use on steam railways in the United States and also in Mexico, South America, Australia and elsewhere; while the lighter sections, for mining, plantation and other purposes, are in use in almost every country of the world.

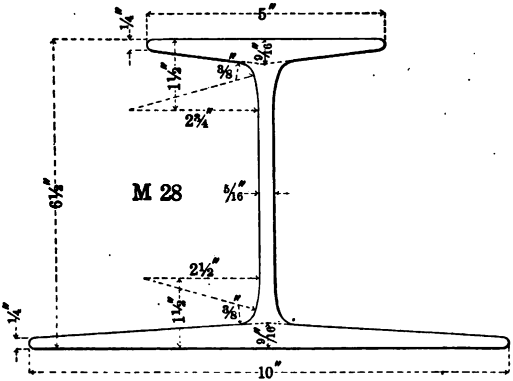
Ties cut from some of these sections can, when required, be bent down at the ends, for which work special estimates will be prepared.

We are prepared to furnish Ties cut to length from any of these sections, punched for bolts and with the necessary clips and bolts for attaching the rails.

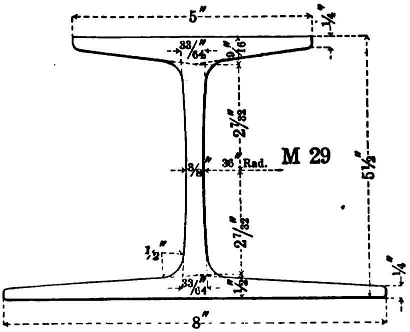
We also furnish ties for portable track, with special clips attached, for use particularly in mines. See page 349.

A separate catalogue describing these ties more fully, as well as the necessary fastenings, and illustrating their use in combination with the Duquesne rail joint (described on pages 335 and 336) will be furnished on request.

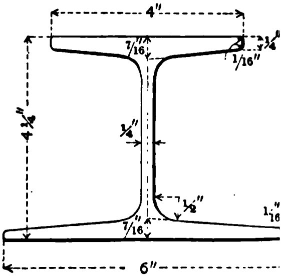
Steel Cross Ties.—*Continued*



Section M—28
Weight 27.8 pounds per foot
(41.37 kilos per meter)



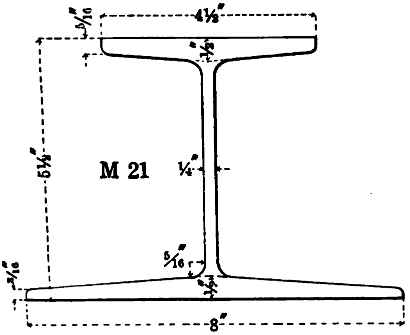
Section M—29
Weight 24 Pounds per Foot
(35.72 Kilos per Meter).



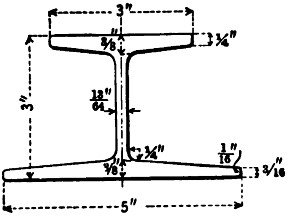
Section M—25
Weight 14.5 Pounds per Foot
(21.58 Kilos per Meter)

Dimensions shown in the above illustrations are in inches. For equiv
in millimeters see pages 14 to 16.

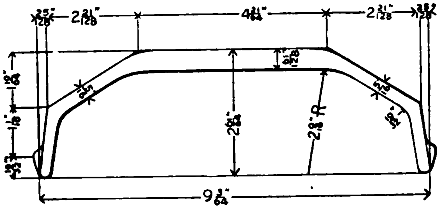
STEEL CROSS TIES.—*Continued*



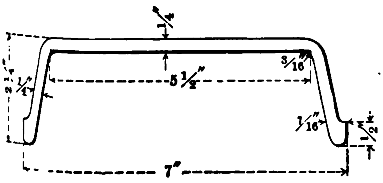
Section M—21
Weight 20 Pounds per Foot
(29.76 Kilos per Meter)



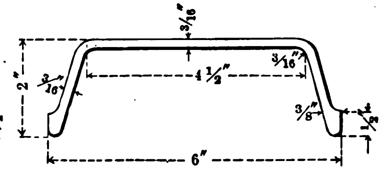
Section M—24
Weight 9.5 Pounds per Foot
(14.14 Kilos per Meter)



Section M—17
Weight 16.4 Pounds per Foot
(24.41 Kilos per Meter)



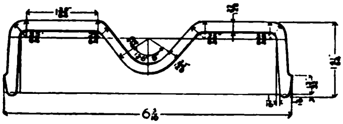
Section M—27
Weight 9 Pounds per Foot
(13.39 Kilos per Meter)



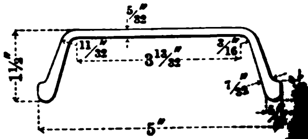
Section M—20
Weight 6 Pounds per Foot
(8.93 Kilos per Meter)

Dimensions shown in the above illustrations are in inches. For equivalents in millimeters see pages 14 to 16.

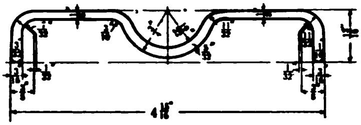
STEEL CROSS TIES.—*Continued*



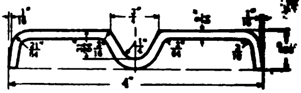
Section M—16
Weight 6.2 Pounds per Foot
(9.23 Kilos per Meter)



Section M—18
Weight 4 Pounds per Foot
(5.95 Kilos per Meter)



Section M—26
Weight 3.2 Pounds per Foot
(4.76 Kilos per Meter)

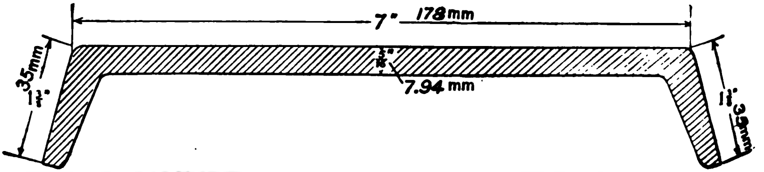


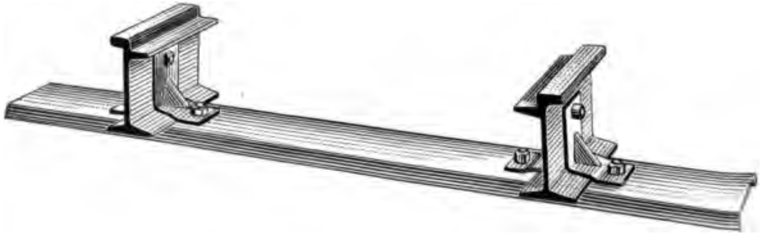
Section M—19
Weight 2.5 Pounds per Foot
(3.72 Kilos per Meter)

Dimensions shown in the above illustrations are in inches. For equivalents in millimeters see pages 14 to 16.

LORAIN STEEL TIE

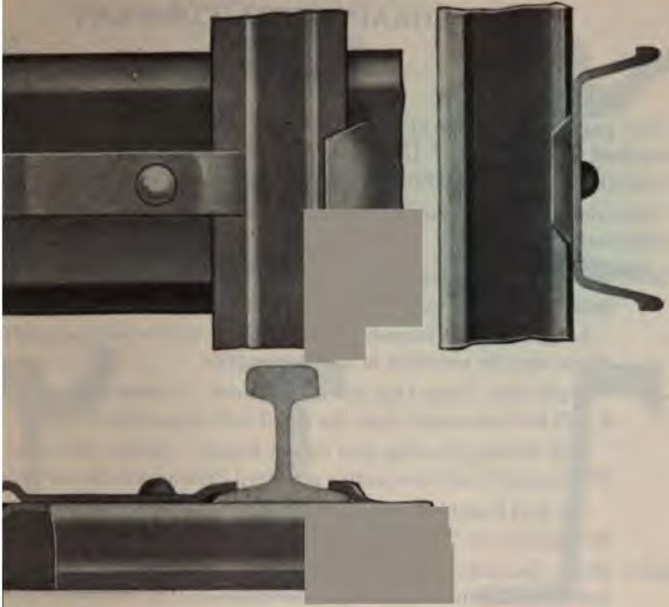
Designed especially for Electric Railways
For use in paved or asphalted streets





Weight of Tie: 30 lbs. per yard (14.88 kilos per meter)
Weight of accessories: Approximately 20 lbs. (9.072 kilos) per tie

Steel Cross Ties.—*Continued*



Sections M 18, M 20 and M 27

ed with No. 26 Clip on inside and Raised Clips on outside of rail

bove illustrations show our special method of attaching rails to the
rtable track for light mine railways.

nly tool needed to attach rails to the ties with this fastening is a

se of the speed with which a portable track of this construction can
or taken down, and because the fastenings are a part of the tie and
cannot be lost, this is the most economical portable track for mine
obtainable.

RAILS AND ACCESSORIES FOR ELECTRIC RAILWAYS AND TRAMWAYS, MANUFACTURED BY THE LORAIN STEEL COMPANY

See pages 364 to 369 of this catalogue for The Lorain Steel Company's Standard specifications. Unless otherwise agreed, material will be manufactured in accordance with these specifications.

Inquiries and orders for Rails and Accessories should specify the following particulars:

Rails: Section and total quantity required: also what proportion of the whole may be supplied in No. 2 (second quality) rails.

Lengths to be furnished as standard, and what proportion of the whole may be supplied in shorter lengths.

State what inspection will be required. Unless otherwise indicated, it will be understood that the usual mill inspection is agreed to.

Rail drilling (spacing and size of holes).—Unless otherwise specified, The Lorain Steel Company's standard drilling will be furnished.

Tie Rod Punching.—Give spacing and sizes of holes, and state whether for opposite or broken joints.

Splice Bars: Quantity, section and length. Punching (spacing and size of holes) of outside bar and of inside bar. Unless otherwise specified, The Lorain Steel Company's standard punching as shown in their catalogue will be furnished.

Bolts and Nuts: Quantity, diameter and length; also whether square or hexagon nuts. Unless otherwise specified, standards as shown in The Lorain Steel Company's catalogue will be furnished.

Spikes: Quantity and size.

Tie Rods: Quantity and size, and gauge of track.

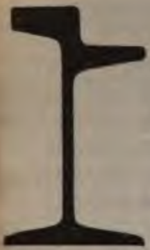
Nutlocks or Washers: Quantity, kind and size.

Tie Plates: State whether Plain, Standard, Brace, or Brace fitting up under head. Refer to The Lorain Steel Company's catalogue.

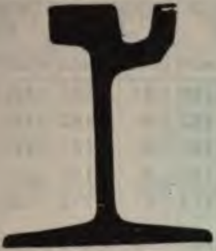
Steel Cross Ties: Section (i. e., Lorain Standard Section as per page 348 or if one of the sections shown on pages 346 to 348 of this catalogue, indicate the section number), length, gauge of track, rail section, and whether Lorain Standard Brace Fastening or Clips and Bolts.

RAILS AND ACCESSORIES FOR ELECTRIC RAILWAYS AND TRAMWAYS, MANUFACTURED BY THE LORAIN STEEL COMPANY.—*Continued*

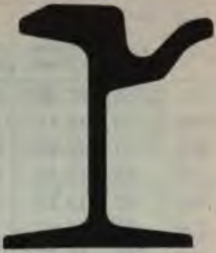
STANDARD TYPES OF RAILS



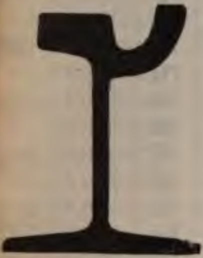
Girder Rail



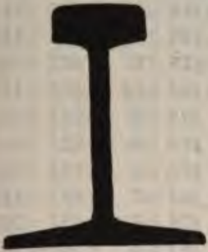
Groove Rail



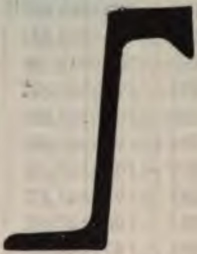
Groove Rail



Guard Rail



High Tee Rail



Slot or Z-Rail

For full size illustrations of the various sections manufactured see illustrated catalogue of The Lorain Steel Company, which will be furnished on request to Engineers, Contractors and others interested in Electric Railway construction.

GIRDER RAILS

Section No.	Weight per Yard, Lbs.	Weight per Meter, Kilos	Height of Rail		Width of Base		Width of Head		Width of Tram Flange		Height of Step	
			Inches	m/m	Inches	m/m	Inches	m/m	Inches	m/m	Inches	m/m
291	73	36.21	7	178	4½	114	2 7/64	54	2 1/64	51	1 9/64	29
206	90	44.64	8 25/32	223	5½	140	2¼	57	2¾	70	1⅛	29
206	93	46.14										
206	96	47.62										
297	95	47.12	8 29/32	226	5½	140	2 15/64	57	2 49/64	70	1¼	32
486	101	50.10	7	178	5½	140	2 11/16	68	2½	64	1¼	32
452	105	52.09	7½	191	4½	114	2½	64	2 7/16	62	1⅜	35

Rails and Accessories for Electric Railways and Tramways, M
factured by The Lorain Steel Company.—*Continued*

GROOVE RAILS

Section No.	Weight per Yard, Lbs.	Weight per Meter, Kilos	Height of Rail		Width of Base		Width of Head		Width of Groove		Dept Groo
			Inches	m/m	Inches	m/m	Inches	m/m	Inches	m/m	Inches
421	55	27.28	3 1/2	89	4	102	2 5/32	55	1 9/32	33	7/8
326	74	36.71	6	152	6	152	1 27/32	47	1 5/32	29	1
378	81	40.18	4	102	5	127	2 15/64	57	1 9/16	40	1 1/8
379	85	42.16	6	152	6	152	2 1/8	54	1 3/16	30	1 1/32
381	87	43.16	6 7/8	175	6	152	1 31/32	50	1 19/32	40	1 1/8
319	89	44.15	8 25/32	223	5 1/2	140	2 1/4	57	1 7/16	37	1 3/16
319	95	47.12									
439	89	44.15	7	178	6	152	2 1/4	57	1 5/16	33	1 1/8
466	90	44.64	6	152	6 1/2	165	1 31/32	50	1 1/8	29	1 1/8
471	90	44.64	7	178	6	152	2 1/4	57	1 5/16	33	1 1/8
*482	90	44.64	6 1/2	165	6 1/2	165	1 27/32	47	1 1/8	29	1 1/8
350	91	45.14	7	178	6	152	2 15/64	57	1 17/64	32	1 1/16
358	92	45.64	6 1/2	165	6 1/2	165	1 31/32	50	1 7/32	31	1 1/16
430	92	45.64	6 7/8	175	6	152	2 7/32	56	1 19/32	40	1 1/8
419	93	46.14	7	178	5	127	2 15/64	57	1 23/32	44	1 1/4
479	95	47.12	7	178	6	152	2 15/64	57	1 17/64	32	1 1/16
†487	95	47.12	6 1/2	165	7	178	1 29/32	48	1 1/8	29	1 1/8
357	96	47.62	7	178	5	127	2 15/64	57	1 9/16	40	1 1/8
401	97	48.12	6	152	6	152	2 5/8	67	1 9/16	40	1 1/8
420	97	48.12	7	178	5	127	2 5/8	67	1 9/16	40	1 1/8
424	97	48.12	7	178	5 1/2	140	2 1/2	64	1 21/32	42	1 3/8
450	98	48.61	7 1/16	180	6	152	2 1/4	57	1 13/16	46	1 3/16
472	100	49.61	6	152	6 1/2	165	1 61/64	50	61/64	24	1 7/8
°489	100	49.61	6 1/2	165	7	178	1 31/32	50	1 1/8	29	1 1/8
¶436	102	50.60	6 7/8	175	5 1/2	140	2 11/32	60	1 29/32	48	1 7/8
426	103	51.09	7	178	5 1/2	140	3	76	1 21/32	42	1 3/8
478	103	51.09	7	178	5 1/2	140	3	76	1 21/32	42	1 3/8
374	104	51.59	9	229	5 1/2	140	2 1/4	57	1 7/8	48	1 1/4
396	104	51.59	8	203	5 1/2	140	2 5/8	67	1 9/16	40	1 1/8
463	104	51.59	9	229	5 1/2	140	2 1/4	57	1 7/16	37	1 1/4
433	105	52.09	7	178	6	152	2 1/2	64	2	51	1 3/16
‡475	105	52.09	7	178	7	178	2 3/32	53	1 1/8	29	1 1/8

*British standard section No. 1 modified. †British standard section No. 2 modified.
°British standard section No. 3 modified. ‡British standard section No. 4 modified.
¶Suitable for M. C. B. (steam railway) wheel flange.

and Accessories for Electric Railways and Tramways, Manufactured by The Lorain Steel Company.—*Continued*

Groove Rails.—*Continued*

Weight per Yard, Lbs.	Weight per Meter, Kilos	Height of Rail		Width of Base		Width of Head		Width of Groove		Depth of Groove	
		Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m
105	52.09	$7\frac{3}{32}$	180	$6\frac{5}{16}$	160	$2\frac{13}{64}$	56	$1\frac{9}{64}$	29	$1\frac{37}{64}$	40
105	52.09	7	178	6	152	$2\frac{1}{2}$	64	2	51	$1\frac{3}{16}$	30
105	52.09	7	178	$5\frac{1}{2}$	140	$2\frac{11}{16}$	68	$1\frac{55}{64}$	47	$1\frac{3}{8}$	35
106 111	52.58 55.06	9	229	$5\frac{1}{2}$	140	$2\frac{1}{4}$	57	$1\frac{7}{8}$	48	$1\frac{1}{4}$	32
107 112	53.08 55.56	9	229	$5\frac{1}{2}$	140	$2\frac{15}{64}$	57	$1\frac{9}{16}$	40	$1\frac{1}{8}$	29
107	53.08	7	178	7	178	$2\frac{1}{8}$	54	$1\frac{21}{32}$	42	$1\frac{1}{4}$	32
109	54.07	9	229	$5\frac{1}{2}$	140	$2\frac{15}{64}$	57	$1\frac{9}{16}$	40	$1\frac{1}{8}$	29
110	54.57	7	178	7	178	$2\frac{7}{32}$	56	$1\frac{1}{8}$	29	$1\frac{1}{8}$	29
110	54.57	7	178	4	102	$2\frac{3}{4}$	70	$1\frac{25}{32}$	45	$1\frac{5}{16}$	33
110	54.57	7	178	5	127	$2\frac{1}{4}$	57	$1\frac{37}{64}$	40	$1\frac{1}{8}$	29
114	56.55	7	178	$5\frac{1}{2}$	140	3	76	$1\frac{7}{8}$	48	$1\frac{1}{2}$	38
115	57.04	7	178	$5\frac{1}{2}$	140	3	76	$1\frac{7}{8}$	48	$1\frac{1}{2}$	38
116	57.54	7	178	$5\frac{1}{2}$	140	3	76	$1\frac{7}{8}$	48	$1\frac{1}{2}$	38
116	57.54	7	178	$5\frac{1}{2}$	140	3	76	$1\frac{7}{8}$	48	$1\frac{1}{2}$	38
120	59.53	$7\frac{3}{16}$	183	$5\frac{1}{2}$	140	3	76	$1\frac{7}{8}$	48	$1\frac{11}{16}$	43
122	60.52	7	178	6	152	3	76	$2\frac{1}{8}$	54	$1\frac{7}{16}$	37
122	60.52	7	178	6	152	3	76	$2\frac{1}{8}$	54	$1\frac{7}{16}$	37
124	61.51	9	229	6	152	$2\frac{3}{4}$	70	$1\frac{3}{8}$	35	$1\frac{5}{16}$	33
125	62.01	9	229	$5\frac{1}{2}$	140	3	76	2	51	$1\frac{1}{2}$	38
127	63.00	9	229	$5\frac{1}{2}$	140	$2\frac{3}{4}$	70	$1\frac{25}{32}$	45	$1\frac{5}{16}$	33
128	63.50	7	178	6	152	3	76	$2\frac{3}{8}$	60	$1\frac{3}{4}$	44
129	63.99	9	229	6	152	$2\frac{3}{4}$	70	$1\frac{3}{4}$	44	$1\frac{1}{4}$	32
129	63.99	9	229	6	152	$2\frac{3}{4}$	70	$1\frac{25}{32}$	45	$1\frac{5}{16}$	33
132	65.48	9	229	$5\frac{1}{2}$	140	3	76	2	51	$1\frac{1}{2}$	38
134	66.47	9	229	6	152	3	76	$2\frac{1}{8}$	54	$1\frac{7}{16}$	37
140	69.45	9	229	$6\frac{1}{2}$	165	3	76	$2\frac{7}{16}$	62	$1\frac{5}{16}$	33
140	69.45	9	229	$6\frac{1}{2}$	165	3	76	$2\frac{7}{16}$	62	$1\frac{5}{16}$	33
141	69.95	9	229	$6\frac{1}{2}$	165	3	76	$1\frac{7}{8}$	48	$1\frac{1}{4}$	32
141	69.95	9	229	6	152	$2\frac{7}{32}$	56	$2\frac{35}{64}$	65	$1\frac{3}{4}$	44
154	76.39	9	229	6	152	3	76	$2\frac{3}{8}$	60	$1\frac{3}{4}$	44

ritish standard section No. 5 modified.
uitable for M. C. B. (steam railway) wheel flange.

Rails and Accessories for Electric Railways and Tramways, Ma
factured by The Lorain Steel Company.—*Continued*

GUARD RAILS

Section No.	Weight per Yard, Lbs.	Weight per Meter, Kilos	Height of Rail		Width of Base		Width of Head		Width of Groove		Width of Guard		Heigh Gua above H	
			Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m
425	88	43.66	6½	165	4½	114	1 31/32	50	1 17/32	39	1	25	5/16	7
359	95	47.12	6½	165	6½	165	1 31/32	50	1 19/64	33	39/64	15	⅛	3
*483	96	47.62	6½	165	6½	165	1⅞	48	1¼	32	27/32	21	Level	
267	97	48.12	6	152	4	102	2 7/64	54	1 9/16	40	1 7/32	31	⅜	9
451	98	48.61	4 13/16	122	5	127	2 13/32	61	1 9/16	40	61/64	24	⅜	9
382	99	49.11	6⅞	175	6	152	1 31/32	50	1 7/16	37	1	25	⅜	9
431	100	49.61	6⅞	175	6	152	2 7/32	56	1½	38	⅞	22	⅜	9
†488	101	50.10	6½	165	7	178	1 15/16	49	1¼	32	27/32	21	Level	
351	102	50.60	7	178	6	152	2 15/64	57	1⅜	35	53/64	21	¼	6
438	102	50.60	6½	165	6½	165	1 31/32	50	1 7/32	31	1	25	⅜	9
353	104	51.59	9	229	5	127	2⅛	54	1¼	32	1 1/16	27	¼	6
377	106	52.58	7	178	6	152	2 15/64	57	1 11/32	34	53/64	21	¼	6
407	106	52.58	9	229	5	127	2⅛	54	1¼	32	1 1/16	27	¼	6
°490	106	52.58	6½	165	7	178	2	51	1¼	32	27/32	21	Level	
290	107	53.08	7⅛	181	4	102	1 63/64	50	1 9/16	40	1 7/32	31	⅜	9
352	107	53.08	9	229	5	127	2⅛	54	1 9/16	40	1⅛	29	⅜	9
398	108	53.58	7	178	5	127	2¼	57	1 9/16	40	1 7/32	31	⅜	9
406	109	54.07	9	229	5	127	2⅛	54	1 9/16	40	1⅛	29	⅜	9
449	109	54.07	9	229	5 1/16	129	2 5/32	55	1¼	32	1 3/32	28	¼	6
473	109	54.07	6	152	6½	165	1 61/64	50	1¼	32	13/16	21	⅜	9
‡476	111	55.06	7	178	7	178	2⅛	54	1¼	32	27/32	21	Level	
480	114	56.55	7	178	5	127	2¼	57	1 21/32	42	1 21/64	34	11/32	8
x485	116	57.54	7	178	7	178	2¼	57	1¼	32	⅞	22	Level	
228	117	58.04	8 25/32	223	5½	140	2¼	57	1 9/16	40	1 7/32	31	⅜	9
448	117	58.04	7	178	7	178	2⅛	54	1 7/16	37	1	25	¼	6
341	119	59.03	9	229	5½	140	2 15/64	57	1 17/32	39	1 7/32	31	⅜	9
469	120	59.53	7	178	5½	140	2½	64	1½	38	1⅜	35	⅜	9
=397	127	63.00	7	178	5½	140	3	76	1⅞	48	1	25	¼	6
461	129	63.99	9	229	5½	140	2¼	57	1 9/16	40	1⅛	29	⅜	9
443	132	65.48	7	178	5½	140	3	76	1 9/16	40	1 3/16	30	⅜	9
464	140	69.45	7 3/16	183	6	152	3	76	1 9/16	40	1⅛	29	3/16	4
468	140	69.45	7	178	6	152	3	76	1 11/16	43	1¼	32	⅜	9
409	143	70.94	9	229	6	152	3	76	1¼	32	1 1/16	27	¼	6
410	145	71.93	9	229	6	152	2¾	70	1⅝	41	1¼	32	⅜	9
445	148	73.41	9	229	6	152	3	76	1 9/16	40	1⅛	29	⅜	9
441	150	74.41	9	229	6	152	3	76	1⅝	41	1 7/16	37	⅜	9
=384	164	81.35	9	229	6	152	2¾	70	2	51	1 5/32	29	⅜	9

*British Standard Section 1C modified.
†British Standard Section 2C modified.
°British Standard Section 3C modified.
‡British Standard Section 4C modified.
xBritish Standard Section 5C modified.
=Suitable for M. C. B. (steam railway) wheel fla

ND ACCESSORIES FOR ELECTRIC RAILWAYS AND TRAMWAYS, MANUFACTURED BY THE LORAIN STEEL COMPANY.—*Continued*

HIGH TEE RAILS

Weight per Yard, Lbs.	Weight per Meter, Kilos	Height of Rail		Width of Base		Width of Head	
		Inches	m/m	Inches	m/m	Inches	m/m
60	29.76	6	152	5	127	$2\frac{1}{8}$	54
70	34.72	7	178	$5\frac{1}{2}$	140	$2\frac{1}{8}$	54
72	35.72	6	152	5	127	$2\frac{5}{16}$	59
79	39.19	8	203	$5\frac{1}{2}$	140	$2\frac{1}{4}$	57
80	39.68	7	178	6	152	$2\frac{1}{2}$	64
87	43.16	$7\frac{1}{4}$	184	6	152	$2\frac{1}{2}$	64
91	45.14	7	178	6	152	$2\frac{3}{4}$	70
95	47.12	7	178	6	152	3	76
175	86.81	6	152	6	152	4	102

SLOT OR Z RAILS

Weight per Yard, Lbs.	Weight per Meter, Kilos	Height of Rail		Width of Base		Width of Head	
		Inches	m/m	Inches	m/m	Inches	m/m
62	30.75	$6\frac{1}{16}$	154	$2\frac{31}{32}$	75	$2\frac{3}{16}$	56
66	32.74	7	178	$3\frac{1}{4}$	83	$2\frac{15}{32}$	63
67	33.24	7	178	3	76	$2\frac{1}{2}$	64
70	34.72	7	178	$3\frac{1}{2}$	89	$2\frac{1}{2}$	64
81	40.18	8	203	$5\frac{3}{8}$	136	$2\frac{15}{32}$	63

TEE RAIL GUARDS

Weight per Yard, Lbs.	Weight per Meter, Kilos	Used with
41.4	20.54	85-lb. A. S. C. E. Section
43.0	21.33	70-lb. A. S. C. E. Section

STRINGER GUARD RAILS

Weight per Yard, Lbs.	Weight per Meter, Kilos	Height of Rail		Width of Base		Width of Head		Width of Groove		Depth of Groove	
		Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m
60	29.76	$1\frac{15}{32}$	38	$4\frac{3}{4}$	121	$1\frac{7}{8}$	48	$1\frac{9}{16}$	40	$\frac{31}{32}$	25
94	46.63	$2\frac{1}{2}$	64	$4\frac{1}{2}$	114	$2\frac{1}{2}$	64	$1\frac{9}{16}$	40	$1\frac{1}{16}$	27
110	54.58	$2\frac{1}{2}$	64	$4\frac{27}{32}$	123	$2\frac{1}{4}$	57	$1\frac{9}{16}$	40	$1\frac{1}{8}$	29

CENTER BEARING RAILS

eight per ard, bs.	Weight per Meter, Kilos	Height of Rail		Width of Base		Width of Head		Width of Tram Flange		Height of Step	
		Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m
106	52.58	$8\frac{7}{8}$	225	$5\frac{1}{2}$	140	$1\frac{31}{32}$	50	$1\frac{3}{8}$	35	$1\frac{23}{64}$	35

RAILS AND ACCESSORIES FOR ELECTRIC RAILWAYS AND TRAMWAYS, M
FACTURED BY THE LORAIN STEEL COMPANY.—*Continued*

SPLICE BARS

Thickness and weight per yard and per meter of Fishplates for the secti
Rails shown on pages 351 to 355

(NOTE.—These fishplates can be supplied in any lengths desired. particulars of the standard rail joints and standard drilling as usually su see the special catalogue of The Lorain Steel Company, which will be fur on request to Engineers, Contractors and others interested.)

For Rail Section No.	Inside Bar				Outside Bar		
	Thickness		Weight		Thickness		Weigh
	Inches	m/m	Per Yard, Lbs.	Per Meter, Kilos	Inches	m/m	Per Yard, Lbs.
206 No. 2	$1\frac{1}{16}$	27	61.72	30.62	$1\frac{1}{16}$	27	71.26
228 No. 2	$1\frac{1}{16}$	27	61.72	30.62	$1\frac{1}{16}$	27	71.26
263	$\frac{1}{2}$	13	27.40	13.59	$\frac{1}{2}$	13	27.40
264	$\frac{5}{8}$	16	38.37	19.03	$\frac{5}{8}$	16	38.37
267	$\frac{1}{2}$	13	23.20	11.51	$\frac{1}{2}$	13	32.70
290	$\frac{3}{4}$	19	43.35	21.50	$\frac{3}{4}$	19	49.24
291	$\frac{3}{4}$	19	43.35	21.50	$\frac{3}{4}$	19	51.47
297 No. 2	$1\frac{1}{16}$	27	61.72	30.62	$1\frac{1}{16}$	27	71.26
319 No. 2	$1\frac{1}{16}$	27	61.72	30.62	$1\frac{1}{16}$	27	71.26
326	$\frac{1}{2}$	13	25.56	12.68	$\frac{1}{2}$	13	25.56
331	$\frac{5}{8}$	16	38.78	19.24	$\frac{5}{8}$	16	38.78
333 No. 2	$1\frac{1}{16}$	27	63.65	31.57	$1\frac{1}{16}$	27	71.24
335	$\frac{5}{8}$	16	38.57	19.13	$\frac{5}{8}$	16	38.57
340 No. 2	$1\frac{1}{16}$	27	63.65	31.57	$1\frac{1}{16}$	27	71.17
341 No. 2	$1\frac{1}{16}$	27	63.65	31.57	$1\frac{1}{16}$	27	71.17
350	$\frac{9}{16}$	14	34.20	16.96	$\frac{9}{16}$	14	40.10
351	$\frac{9}{16}$	14	34.20	16.96	$\frac{9}{16}$	14	40.10
352	$\frac{5}{8}$	16	51.26	25.43	$\frac{5}{8}$	16	58.37
353	$\frac{5}{8}$	16	51.26	25.43	$\frac{5}{8}$	16	58.37
357	$\frac{3}{4}$	19	42.64	21.15	$\frac{3}{4}$	19	48.63
358	$\frac{3}{4}$	19	40.81	20.24	$\frac{3}{4}$	19	42.84
359	$\frac{3}{4}$	19	40.81	20.24	$\frac{3}{4}$	19	42.84
364 No. 2	$1\frac{1}{16}$	27	61.72	30.62	$1\frac{1}{16}$	27	61.72
373	$\frac{5}{8}$	16	46.20	22.92	$\frac{5}{8}$	16	46.20
374 No. 2	$1\frac{1}{16}$	27	61.72	30.62	$1\frac{1}{16}$	27	71.26
375	$\frac{5}{8}$	16	38.57	19.13	$\frac{5}{8}$	16	38.57
377	$\frac{9}{16}$	14	34.20	16.96	$\frac{9}{16}$	14	38.47
379	$\frac{3}{4}$	19	35.22	17.47	$\frac{3}{4}$	19	39.40
381	$\frac{5}{8}$	16	38.07	18.88	$\frac{5}{8}$	16	43.45

Splice Bars for Rail Section No. 378 are: for Inside Bar, 1½ inch Flat for Outside Bar, 1 inch Flat Bar.

Rails and Accessories for Electric Railways and Tramways, Manufactured by The Lorain Steel Company.—*Continued*

Splice Bars.—*Continued*

For Rail Section No.	Inside Bar				Outside Bar			
	Thickness		Weight		Thickness		Weight	
	Inches	m/m	Per Yard, Lbs.	Per Meter, Kilos	Inches	m/m	Per Yard, Lbs.	Per Meter, Kilos
382	5/8	16	38.07	18.88	5/8	16	43.45	21.55
384	11/16	17	49.50	24.55	11/16	17	59.60	29.56
393	7/8	22	47.70	23.66	7/8	22	61.90	30.71
395	1	25	56.85	28.20	1	25	65.37	32.43
396	5/8	16	44.36	22.00	5/8	16	50.45	25.02
397	7/8	22	47.70	23.66	7/8	22	61.90	30.71
398	3/4	19	42.64	21.15	3/4	19	48.63	24.12
399	5/8	16	38.37	19.03	5/8	16	38.37	19.03
400 No. 1	5/8	16	38.99	19.34	5/8	16	38.99	19.34
400 No. 2	1 1/8	29	61.60	30.55	1 1/8	29	61.60	30.55
401	3/4	19	33.48	16.61	1	19	40.10	19.89
402	1	25	56.34	27.95	1	25	65.37	32.43
403	11/16	17	54.82	27.19	3/4	19	72.65	36.04
406	5/8	16	51.26	25.43	5/8	16	58.37	28.95
407	5/8	16	51.26	25.43	5/8	16	58.37	28.95
409	1	25	56.85	28.20	1	25	65.37	32.43
410	11/16	17	54.82	27.19	3/4	19	72.65	36.04
418	1 1/8	29	57.66	28.60	1 1/8	29	57.66	28.60
419	3/4	19	42.64	21.15	3/4	19	48.63	24.12
420	3/4	19	42.64	21.15	3/4	19	48.63	24.12
422 No.. 2	1 1/16	27	61.72	30.62	1 1/16	27	71.26	35.35
424 No 1	7/8	22	46.51	23.07	1	25	55.73	27.64
424 No. 2	1 1/8	29	54.21	26.89	1 1/8	29	64.36	31.92
426 No. 1	7/8	22	46.51	23.07	1	25	55.73	27.64
426 No. 2	1 1/8	29	54.21	26.89	1 1/8	29	64.36	31.92
427	1	25	58.57	29.05	1	25	69.84	34.65
430	5/8	16	38.07	18.88	5/8	16	43.45	21.55
431	5/8	16	38.07	18.88	5/8	16	43.45	21.55
432	11/16	17	54.82	27.19	3/4	19	72.65	36.04
433	3/4	19	42.50	21.08	3/4	19	51.30	25.45
434	7/8	22	47.70	23.66	7/8	22	61.90	30.71
436	5/8	16	33.50	16.62	5/8	16	43.45	21.55
437	1 1/4	32	64.46	31.98	1 1/4	32	82.23	40.79
438	3/4	19	40.81	20.24	3/4	19	42.84	21.25
439	3/4	19	43.45	21.50	3/4	19	49.43	24.51
440	1	25	58.57	29.05	1	25	69.84	34.65
441	1	25	58.57	29.05	1	25	69.84	34.65
442	7/8	22	47.70	23.66	7/8	22	61.90	30.71
443	7/8	22	47.70	23.66	7/8	22	61.90	30.71
445	1	25	56.85	28.20	1	25	65.37	32.43
447	25/32	20	41.62	20.65	13/16	21	48.32	23.96
448	25/32	20	41.62	20.65	13/16	21	48.32	23.96
449	5/8	16	51.26	25.43	5/8	16	58.37	28.95

There are no **Splice Bars** for Rail Section No. 425.

Rails and Accessories for Electric Railways and Tramways, M factured by The Lorain Steel Company.—*Continued*

Splice Bars.—*Continued*

For Rail Section No.	Inside Bar				Outside Bar			
	Thickness		Weight		Thickness		Weight	
	Inches	m/m	Per Yard, Lbs.	Per Meter, Kilos	Inches	m/m	Per Yard, Lbs.	M K
450	¾	19	42.64	21.15	¾	19	48.63	24
451	¾	19	29.40	14.58	13/16	21	40.50	20
456	⅞	22	42.46	21.06	1	25	57.16	28
461 No. 2	1 1/16	27	61.72	30.62	1 1/16	27	71.26	35
462	⅞	22	47.70	23.66	⅞	22	61.90	30
463 No. 2	1 1/16	27	61.72	30.62	1 1/16	27	71.26	35
464	⅞	22	47.70	23.66	⅞	22	61.90	30
465	11/16	17	46.91	23.27	11/16	17	55.62	27
466	¾	19	33.48	16.61	¾	19	40.10	19
467 No. 1	⅞	22	47.20	23.41	1	25	57.89	28
467 No. 2	1⅛	29	50.98	25.29	1⅛	29	64.48	31
468 No. 1	⅞	22	47.20	23.41	1	25	57.89	28
468 No. 2	1⅛	29	50.98	25.29	1⅛	29	64.48	31
469	¾	19	42.50	21.08	¾	19	51.30	25
470	1	25	69.84	34.64	1⅛	29	84.46	41
471	¾	19	43.45	21.55	¾	19	49.43	24
474	25/32	20	38.47	19.08	13/16	21	44.86	22
475	25/32	20	38.56	19.13	13/16	21	45.36	22
476	25/32	20	38.56	19.13	13/16	21	45.36	22
477	23/32	18	39.38	19.53	23/32	18	46.69	23
478 No. 1	⅞	22	46.51	23.07	1	25	55.73	27
478 No. 2	1⅛	29	54.21	26.89	1⅛	29	64.36	31
479	9/16	14	34.20	16.96	9/16	14	38.48	19
480	¾	19	42.64	21.15	¾	19	48.63	24
481	¾	19	42.50	21.08	¾	19	51.30	25
482	¾	19	33.80	16.77	25/32	20	39.89	19.
483	¾	19	33.80	16.77	25/32	20	39.89	19.
484 No. 1	⅞	22	46.51	23.07	1	25	55.73	27.
484 No. 2	1⅛	29	54.21	26.89	1⅛	29	64.36	31.
485	25/32	20	38.47	19.08	13/16	21	44.86	22.
486 No. 1	⅞	22	46.51	23.07	1	25	55.73	27.
486 No. 2	1⅛	29	54.21	26.89	1⅛	29	64.36	31.
487	¾	19	33.98	16.86	25/32	20	40.39	20.
488	¾	19	33.98	16.86	25/32	20	40.39	20.
489	¾	19	33.05	16.39	25/32	20	39.60	19.
490	¾	19	33.05	16.39	25/32	20	39.60	19.
491 No. 1	⅞	22	47.20	23.41	1	25	57.89	28.
491 No. 2	1⅛	29	50.98	25.29	1⅛	29	64.48	31.
492	1⅛	29	54.90	27.23	1⅛	29	63.86	31.
493 No. 2	1 1/16	27	61.72	30.62	1 1/16	27	71.00	35.
494	⅞	22	47.70	23.66	⅞	22	61.90	30.
495	⅝	16	37.12	18.41	⅝	16	41.51	20.
496 No. 2	1 1/16	27	61.72	30.62	1 1/16	27	71.00	35.

There are no Splice Bars for Rail Sections Nos. 452, 472 and 473.

INTS, CROSSINGS AND OTHER SPECIAL WORK FOR RAILWAYS AND TRAMWAYS

MANUFACTURED BY THE LORAIN STEEL COMPANY

STING OF: Tongue Switches (Movable Points); Spring Tongue Switches matic Points); Mates (Open Points); Frogs; Crossings; Curved Rails; Overs, Portable or Permanent; Lateral Railway or Steam Railway ngs.

rRUCTION OF SWITCH PIECES, VIZ: Solid Manganese Steel; Iron-Bound ıntee; Cast Steel Guarantee; Cast Steel; Built-Up; Cast-In.

SWITCH PIECES

id Manganese provides for tongue switches, mates, frogs and crossings of Cast Manganese Steel.

n-Bound Guarantee provides for rolled steel rails secured in cast iron s, with cast manganese wearing plates at wheel intersections.

st Steel Guarantee provides for manganese tongue switches, cast steel ;, frogs and crossings, with manganese removable wearing plates at the intersection, secured to the main casting with heat-treated bolts of extra e strength.

st Steel provides for Cast Steel switch pieces without manganese wearing ;.

ilt-Up provides for switch pieces made of rolled steel rails secured together ›olts and brackets, with filling pieces of cast or rolled steel, or cast iron. ndard tee rail layouts are usually of this construction.

st-In provides for rolled rails of girder or tee sections, united at their ections with cast-iron poured hot.

TONGUE SWITCHES

ngue switches and mates for branch-offs or lateral turnouts of either right t hand can be furnished of following radii to track centers; 50 ft., 75 ft., t., 150 ft., 200 ft., or for equilateral turnouts up to 350 ft. The tongue h will be placed on the inner rail of curves, unless otherwise specified.

lid Manganese Tongue Switches of "Tadpole" type provide for a manse casting not less than 12 ft. long for 100 ft. radii, with manganese tongue ecial design, machine finished on all bearing surfaces. A lug is provided ll tongues for attaching electrical or other actuating devices. Ends con- to connecting rail sections. Switches furnished in 9 inch and not less 7 inch construction.

Points, Crossings and Other Special Work for Railways and Tramways, Manufactured by The Lorain Steel Company.—*Continued*

Iron-Bound Guarantee. Tadpole type tongue switches are furnished in iron-bound construction with manganese tongue, and manganese wearing plate extending beyond both point and heel of tongue, secured to the main casting with heat-treated bolts of extra tensile strength.

All switch pieces in iron-bound guarantee construction have rolled rail ends for standard splice bars.

Cast Steel Tongue Switch has no manganese steel wearing plate. The tongue is of forged high carbon steel, enlarged at the heel and provided with a substantial pivot pin and a device for securing the tongue in place.

Built-Up Tongue Switch is made of rolled steel tee rails, with forged high carbon steel tongue of same pattern as the Cast Steel construction. The fillers forming the bed of the tongue are cast iron and the rails are held together with bolts.

Bolted Tee-Rail Tongue Switch can also be furnished with a short manganese steel wearing plate at the point of the tongue.

Connected Tongue Switches. When desired, two tongue switches connected together by switch rod enclosed in a cast iron box, can be supplied, instead of tongue switch and mate. The switch rod can be connected with a throwing device, set against the switch, outside of the track in an auxiliary cast iron box or the throwing mechanism may be contained in the box connecting the switch pieces. The operating device can be used without removing the box cover, which offers no street obstruction above the top of the rail.

MATES

Mates (Open Points) are uniform in length with tongue switches and are made in Solid Manganese Steel; Short Type Manganese Steel, usually for standard tee rail construction; Iron-Bound Guarantee, made of rolled steel rails secured in a cast iron body with a manganese steel wearing plate of ample length secured by bolts, the plate is removable; Cast Steel Guarantee, made of steel casting in one piece with manganese steel wearing plate secured by bolts, the plate is removable; Cast Steel, made in solid cast steel without manganese steel wearing plate; Built-Up, made of girder or tee rails, secured together by bolts.

POINTS, CROSSINGS AND OTHER SPECIAL WORK FOR RAILWAYS AND TRAMWAYS, MANUFACTURED BY THE LORAIN STEEL COMPANY.—*Continued*

Frogs are made in solid manganese steel; or in Iron-Bound, or Cast Steel construction with manganese steel removable wearing plates; solid cast steel without manganese wearing plate, and built-up type made of girder or tee rails held together with bolts.

Bolts used in built-up construction, when subjected to severe strains, are furnished of high tensile quality obtained by superior heat-treatment.

Crossings are furnished in the various constructions described, and those of approximately 90 degree angle are supplied in two pieces. If of 45 degree angle, or less, they may be made in four pieces.

Manganese Steel Wearing Plates used in the several constructions described, are provided with full machined bearing and held securely in place by heat-treated bolts. They are removable and may be replaced by new plates when desirable, or necessary.

Curved Rails. Guard rails, girder or standard tee rails, can be furnished accurately curved to any radius for street or steam railway service.

Manganese Rails. For curves subject to unusually heavy service, the use of cast manganese rails is recommended. These can be furnished of any desired section in lengths of 20 feet or less, and may be accurately curved to meet the requirements of standard street railway service.

Rolled manganese rail can only be furnished conditional upon the quantity being sufficient for a special rolling.

Permanent Cross-Overs manufactured from any standard girder, guard, or tee section.

Portable Cross-Overs manufactured from stringer guard rail, with cast steel switch pieces, suitable for emergency use in city streets, or made of standard tee rail, with switch pieces of same rail section, suitable for temporary use in constructing new tracks or re-building existing tracks. Capable of being moved over permanent tracks without dismantling.

Portable Tracks for industrial service of all standard tee rail sections, riveted to Carnegie, Lorain, or Decauville steel ties, with tongue, or split switches, with necessary ground throw or switch stands, for turnouts of any desired radii, or for curved or straight track, can be furnished complete ready for operation.

Steam Railway Crossings, whether wholly for steam railway use, or for street railway crossing steam railway tracks, can be furnished in solid manganese steel, or manganese steel in the steam railway and rolled rail in the street

POINTS, CROSSINGS AND OTHER SPECIAL WORK FOR RAILWAYS AND TRAMWAYS, MANUFACTURED BY THE LORAIN STEEL COMPANY.—*Continued*

railway track, the outside arms connecting with existing tracks with standard splice bars.

They can also be supplied of any standard tee rail, the several parts being bolted together with large size bolts, forged brackets, rolled steel fillers between rails, and riveted corner plates, with two or three rails in each track.

For small angles, 30 to 15 degrees or less, the crossing, if of standard tee rail, may have manganese centers secured to the rails by heavy bolts, and riveted to base plates if desired.

Rigid, or Spring Split Switches, three-way and slip switches, made of any standard rolled steel tee rail, or with switch points of manganese steel.

Switch Stands, high, intermediate, low and automatic and non-automatic rigid, or with spring, also rail braces, tie plates and all accessories for steam railway switch installation.

LAYOUTS

To permit of the proper construction of special work, we should be provided with a survey of the location of each layout, showing the angle and width of streets, fixing the center lines of tracks, and their distance apart, and we will prepare drawings strictly in accordance with such survey data.

Layouts for each location will be made up complete to tangent points (unless otherwise specifically directed), including switch pieces, with all curved and connecting rails, fishplates, bolts, nuts (and tie bars or steel sleepers when specified), together with such ordinary or special fishplates with bolts and nuts as may be required to make outside connections between the special work and the abutting straight rail.

Plans submitted by us will be prepared to a scale of not less than 1-16 in. to the foot of each layout, showing clearly in heavy lines the extent of track work included in our prices.

All curves in special work have suitable spiral or easement entrances and exits where practicable, the radius of such spirals being maximum at the ends and decreasing therefrom along the spiral until the minimum radius of the curve is reached.

Where the simultaneous passage of cars on double track curves is desired it should be so stated in the inquiry in order that the track design may provide for proper car clearance.

If required, detachable spring boxes can be provided, complete with rod, INTS, CROSSINGS AND OTHER SPECIAL WORK FOR RAILWAYS AND TRAMWAYS, MANUFACTURED BY THE LORAIN STEEL COMPANY.—*Continued*

lts and spring, for attachment to movable points to make the same automatic. In such cases the tongues of movable points are provided with properly signed lugs for coupling with spring. The spring mechanism is of such a sign that it can be readily adjusted for tongue to be set to right or to left, may be required for automatic operation.

Further details of construction and drawings will be furnished upon application from tramway officials or buyers.

INFORMATION REQUIRED FOR TRACK SPECIAL WORK FOR TRAMWAYS

In ordering, or submitting inquiries for special work, information as to the ollowing details should be supplied the manufacturer:

Whether for street or steam railway.

Gauge of track.

Distance center to center of tracks.

Rail sections and splice bar drilling.

Electrical bond drilling.

Tie rods: spacing and diameter of ends.

Steel ties (Sleepers) section number, length and spacing.

Rail braces and spikes.

Wheel dimensions: Width of tread, thickness and depth of flange.

Connecting rail sections, section number or scribing and drilling.

When car clearance is required, the outside dimensions of car bodies, including platforms and fenders, wheel base, and truck centers for double truck equipment, should be given.

If automatic throwing device is required on tongue switches, a lug on the tongue will be provided for same.

Construction: whether Solid Manganese Steel, Cast Steel Guarantee, Iron-Bound Guarantee, Regular or Built-Up.

FOR STEAM RAILWAY SPLIT SWITCHES

Information in addition to the foregoing is required, viz:

Length of switch points.

Type of switch, whether Rigid or Spring.

Type of switch stand, and amount of throw.

Number, or angle, of frog.

Unless reference is made to Lorain drawings, or catalogue cuts, it will be necessary to state the number of switch rods, slide plates, and braces.

LORAIN TRAMWAY RAILS MANUFACTURED TO STANDARD SPECIFICATIONS FOR OPEN HEARTH STEEL GIRDER, GROOVED, HIGH TEE RAILS AND SPLICE BARS

Adopted June 1, 1915

Corresponding to Recommended Practice of American Electric Railway Engineering Association and American Society for Testing Materials

Manufacture

1. *Process.* The steel shall be made by the Open Hearth process. The entire process of manufacture and testing shall accord with the best current practice.

2. *Bled Ingots.* Bled ingots and ingots or blooms which show the effects of injurious treatment shall not be used.

3. *Discard.* A sufficient discard from the top of each ingot shall be made at any stage of the manufacture to obtain sound rails. When finished rails show piping, they may be cut to shorter lengths until all evidence of this is removed.

Chemical Properties and Tests

4. *Chemical Composition.* The steel shall conform to either of the following requirements as to chemical composition, as specified in the order:

	Class "A"	*Class "B"*
Carbon, per cent	0.60—0.75	0.70—0.85
Manganese, per cent	0.60—0.90	0.60—0.90
Silicon, per cent	Not over 0.20	Not over 0.20
Phosphorus, per cent	Not over 0.04	Not over 0.04
Sulphur, per cent	Not over 0.06	Not over 0.06

5. *Ladle Analyses.* To determine whether the material conforms to the requirements specified in Section 4, an analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt. Drillings shall be taken for analysis not less than ¼ inch (6.35 m/m) beneath the surface of the test ingot. A copy of this analysis shall be given to the purchaser or his representative.

6. *Check Analyses.* A check analysis may be made from time to time by the purchaser from a test ingot or drillings therefrom furnished by manufacturer.

Physical Properties and Tests

7. *Drop Tests.* (*a*) One specimen from each melt shall be tested on a drop test machine having a tup of 2,000 pounds (907 kilos) weight, the striking face of which shall have a

STANDARD SPECIFICATIONS FOR LORAIN RAILS.—*Continued*

radius of not more than five inches (127 m/m) and the test rail shall be placed head upward on solid supports three feet (914 m/m) apart. The anvil block shall weigh at least 20,000 pounds (9072 kilos) and the supports shall be part of, or firmly secured to, the anvil.

Weight of Rail		Height of Drop			
Pounds	Kilos	Class "A"		Class "B"	
Per Yard	Per Meter	Feet	Meters	Feet	Meters
50 to 60	24.80 to 29.76	15	4.572	12	3.658
61 to 80	30.25 to 39.68	16	4.877	13	3.963
81 to 90	40.18 to 44.64	17	5.182	14	4.267
91 and upwards	45.14 and upwards	18	5.486	15	4.572

(*b*) The atmospheric temperature at the time of testing shall not be less than 60 degrees Fahrenheit or more than 120 degrees Fahrenheit, and be recorded in the test report.

(*c*) The testing shall proceed concurrently with the operation of the works.

(*d*) Drop test specimens shall not be less than four feet (1.219 m.) nor more than six feet (1.829 m.) in length.

8. *Tensile Test.* For each rolling, or for each 100 English or metric tons, a tensile test piece shall be prepared having, where practicable, a sectional area of 0.5 square inch (322.58 square millimeters) for a distance of two inches (50.8 millimeters) between gauge points. Each piece shall show the following minimum physical qualities:

	Class "A"	Class "B"
Ultimate Strength...	100,000 lbs. per sq. in. (70.3 k. per sq. m/m)	110,000 lbs. per sq. in. (77.3 k. per sq. m/m)
Elongation in 2 inches (50.8 m/m).......	10%	8%

9. ***Bending Tests.*** The rails shall be capable of being bent when cold to a radius of 30 feet (9.144 meters) without any sign of fracture.

10. ***Impression Test.*** As an alternative to the tensile test some pieces of rail shall be tested for hardness by impression on the head with a ball 19 m/m diameter loaded with 50 tons (50,800 kilos) and the depth of the impression shall not be more than 4 m/m for Class "A" Rails and 3.8 m/m for Class "B" Rails.

STANDARD SPECIFICATIONS FOR LORAIN RAILS.—*Continued*

11. *Retests.* If any of the above test pieces fail to stand the tests required two additional samples shall be taken from two rails of the same heat, and be subjected to the test under which failure occurred. If both of these pieces meet the requirements all the rails of the heat which they represent will be accepted.

Standard Sections, Lengths and Weights

12. *Section.* (*a*) The cold template of the manufacturer shall conform to the specified section as shown in detail on the drawing of the purchaser, and shall at all times be maintained perfect.

(*b*) The section of the rail shall conform as accurately as possible to the template, and within the following tolerances

(1) The height shall not vary more than $\frac{1}{64}$ inch (.397 m/m) under, nor more than $\frac{1}{32}$ inch (.794 m/m) over that specified.

(2) The over-all width of head and tram shall not vary more than ⅛ inch (3.175 m/m) from that specified. Any variation which would affect the gauge line more than $\frac{1}{32}$ inch (.794 m/m) will not be allowed.

(3) The width of base shall not vary more than ⅛ inch (3.175 m/m) under that specified for widths less than 6½ inches (165.10 m/m); $\frac{3}{16}$ inch (4.763 m/m) under for a width of 6½ inches (165.10 m/m); and ¼ inch (6.35 m/m) under for a width of 7 inches (177.80 m/m).

(4) The variation in the distance between splicing surfaces shall not exceed $\frac{1}{64}$ inch (.397 m/m) above or below standard dimensions. A good fit of the splice bars must be maintained.

(5) The base of the rail shall be at right angles to the web; and the convexity shall not exceed $\frac{1}{32}$ inch (.794 m/m).

(*c*) When necessary on account of the type of track construction, and notice to that effect has been given to the manufacturer, special care shall be taken to maintain the proper position of the gauge line with respect to the outer edge of the base.

13. *Length.* The normal length of rails for straight or curved track shall be one of the standards given below, the maximum permissible variation being ¼ inch (6.35 m/m measured at 60 degrees Fahrenheit, from the length specified

STANDARD SPECIFICATIONS FOR LORAIN RAILS.—*Continued*

Straight Track. (*a*) Standard 60 feet with not exceeding 10 per cent. in lengths of 55 feet, 50 feet, 40 feet, and 30 feet.

(*b*) Standard 45 feet with not exceeding 10 per cent. in lengths of 40 feet, 35 feet, and 30 feet.

(*c*) Standard 18 meters with not exceeding 10 per cent. in lengths of 16.5, 15, 13.5, and 12 meters.

(*d*) Standard 15 meters with not exceeding 10 per cent. in lengths of 13.5, 12 and 10.5 meters.

Curve Track. (*e*) Standard 35 feet with not exceeding 5 per cent. 30 feet, 2½ per cent. 25 feet, and 2½ per cent. 20 feet.

(*f*) Standard 30 feet with not exceeding 5 per cent. 25 feet and 5 per cent. 20 feet.

(*g*) Standard 12 meters with not exceeding 10 per cent. in lengths of 10.5 and 9 meters.

14. *Weight.* (*a*) The weight of the rails per yard as specified in the order shall be maintained as nearly as possible after conforming to the requirements specified in Section 13.

(*b*) The total weight of an order shall not vary more than .05 per cent. from that specified.

(*c*) Payment shall be based on actual finished weights shipped.

Workmanship and Finish

15. *Straightening.* (*a*) Rails on the hot beds shall be protected from water or snow, and shall be carefully manipulated to minimize cold-straightening.

(*b*) The distance between the rail supports in the cold-straightening presses shall not be less than 42 inches (1.0674 m.) except as may be necessary near the ends of the rails. The gag shall have rounded corners to avoid injury to the rails.

16. *Drilling and Punching.* (*a*) Circular holes for joint bolts, bonds and tie-rods shall be drilled to conform to the drawings and dimensions furnished by the purchaser.

(*b*) In Class "A" rails the tie-rod holes may be punched, also in Class "B" when slotted holes are specified

17. *Milling.* The ends shall be milled square laterally and vertically, but the base may be undercut $\frac{1}{32}$ inch (.794 m/m).

STANDARD SPECIFICATIONS FOR LORAIN RAILS.—*Continued*

18. *Finish.* (*a*) Rails shall be smooth on the head, straigh in line and surface, without any twists, waves or kink particular attention being given to having the ends withou kinks or drop.

(*b*) All burrs or flow caused by drilling or sawing shal be carefully removed.

(*c*) Rails shall be free from gag marks and other injurious defects of cold-straightening.

Marking and Loading

19. *Marking.* (*a*) The name or brand of the manufacturer the customer's mark, the year and month of manufacture, th letters "O. H.," the weight of the rail, and the section number shall be legibly rolled in raised letters and figures on the web The melt number shall be legibly stamped on each rail wher it will not be covered subsequently by the joint plates.

(*b*) Both ends of all short-length rails shall be painte green.

20. *Loading.* (*a*) Rails shall be loaded in the presence o the inspector, and shall be handled in such a manner as not to bruise the flanges or cause other injuries.

(*b*) Rails of each class shall be placed together i loading.

(*c*) Rails shall be paired as to length before shipment

SPLICE BARS

Process of Manufacture

21. *Process.* The steel will be of the best quality, Siemens-Martin Open Hearth or Bessemer, at the option of the manufacturer.

Chemical Composition

22. *Chemical Composition.* For Open Hearth Steel th carbon content will not be less than 0.15 per cent. and fo Bessemer Steel the carbon content will not exceed 0.15 pe cent.

Physical Properties and Tests

23. *Physical Tests.* A test piece taken from the upper par of the fishplate for each lot of 50 tons or for smaller quantities will yield the following results:

(*a*) Ultimate strength—55,000 to 65,000 pounds pe square inch (38 to 45 kilos per square m/m).

Standard Specifications for Lorain Rails.—*Continued*

(*b*) Elastic Limit—Not less than one-half of the ultimate strength.

(*c*) Elongation—Not less than 25 per cent. measured in a length of two inches (50.80 m/m)

(*d*) Bending Test—180 degrees cold, flat on itself, without cracking on outside of bent portion.

Finish

24. *Finish.* The fishplates will be sheared to the desired length, and will be punched for bolt holes, except that circular holes may be drilled.

25. *Dipping and Bundling.* All approved fishplates shall be dipped into hot boiled linseed oil, or other liquid approved by the engineer, and shall be wired up in bundles. Each bundle to consist of two inside and two outside plates.

26. *Payment by Weight.* Payment for the fishplates will be made according to the actual weight.

27. Note.—Fishplates ordered in large quantities, at the same time as the rails, can be furnished in the same quality of steel as the Open Hearth Rails. This to be at the option of purchaser. In this event it will be necessary to modify the physical tests as specified.

Inspection

28. *Inspection.* The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests and inspection shall be made at the place of manufacture prior to shipment, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

29. *Over-Rolling.* Except when specifically stated to the contrary the quantity ordered may be increased by not more than 5 per cent. to include any over-rolling.

COPPER RAIL BONDS

for

Electric Railways and Tramways

The American Steel and Wire Company's "Crown" and "United States" Rail Bonds combine in the highest degree all the essentials of a first-class bond, viz: the very highest grade of material, superior workmanship and correct principles of construction and application.

The American Steel and Wire Company manufactures four styles of Rail Bonds:

Crown Rail Bonds, having single stud terminals either solid for compression, or tubular for pin expansion, the conductors between the terminals being either single solid wires or strands composed of a number of small round wires.

United States Rail Bonds, having single stud terminals either solid for compression, or tubular for pin expansion, the conductor being composed of flat strips or ribbons.

Multi-Terminal Rail Bonds having two or more studs on each terminal, the conductors between the terminals being composed either of a number of small round wires, or of flat ribbons.

Soldered Rail Bonds, having flat terminals, the connection with the rails being made with solder, the conductors between the terminals being composed either of a number of small round wires, or of flat ribbons.

The American Steel and Wire Company also manufactures a very complete outfit of high-grade Tools for installing bonds, and have ample facilities for making Rail Bonds or Tools of special design for special conditions. To insure quick deliveries, however, standard types and dimensions should be specified by purchasers whenever possible.

In the following pages are shown a few of the many types of Rail Bonds manufactured by the American Steel and Wire Company. We can furnish to order Bonds of any desired length or capacity to meet all conditions.

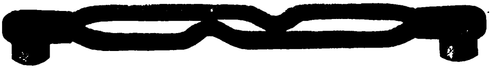
For further particulars see the American Steel and Wire Company's illustrated Rail Bond catalogue, which we will furnish on request to Engineers, Contractors and others interested in Electric Railway construction and maintenance.

We solicit inquiries for prices and for information on any rail-bonding probems, asking particularly that the conditions be fully described to us.

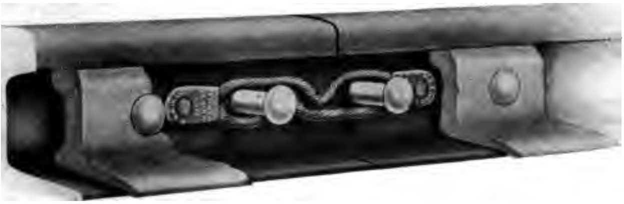
Copper Rail Bonds.—*Continued*

CROWN RAIL BONDS

All single-stud terminal bonds, the conductors of which are composed either of single solid wires or of one or more strands, each strand composed of small round wires, are known as Crown Bonds. They are made with both styles of terminals: the tubular terminal, known as type C. P. (C-rown P-in) Bonds, and the solid compression stud terminal, known as type C. S. (C-rown S-olid) Bonds. The various forms of conductors connecting terminals are given arbitrary numerals or letters to distinguish the bonds. Round wire strands are flexible equally in all planes. Each wire supports and strengthens its neighboring wires, and individual wires cannot escape from the strand to be caught between the joint plates and the head or flange of the rail. The treatment of the copper in the production of round annealed wires toughens the metal advantageously. In these respects, round-wire strands are superior to flat-wire conductors. In many of the flexible Crown Bonds, the wires are twisted into a hollow strand. This construction renders the bonds extremely pliable and prevents injury to the individual wires or the whole strand by pressure from the joint plates.



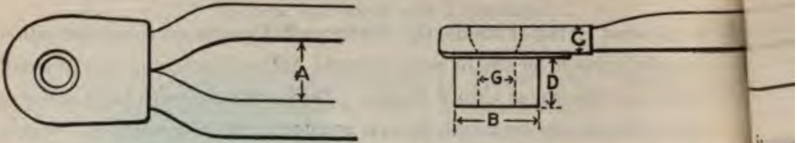
Crown Flexible Rail Bond



Showing Application of Rail Bond Illustrated Above

COPPER RAIL BONDS.—*Continued*

CONCEALED RAIL BONDS FOR RAIL WEBS



STANDARD DIMENSIONS OF CROWN RAIL BONDS

(Dimensions in inches. For equivalents in Millimeters, see page 373.)

Bond Terminals

Size of Bond	Outside Diameter B of Stud	Solid Stud Terminals		Tubular Stud Terminals		
		Length of Stud under Head, D	Thickness of Crown or Head, C	Length of Stud under Head, D	Thickness of Crown or Head, C	Diameter of Hole Through Stud, G
1/0	½	¾	¼	9/16	¼	3/16
2/0	⅝	¾	9/32	9/16	9/32	9/32
3/0	¾	¾	5/16	9/16	5/16	11/32
4/0	⅞	¾	5/16	9/16	5/16	13/32
300,000 C. M.	1	¾	⅜	⅝	⅜	9/16
500,000 C. M.	1	¾	⅜	⅝	⅜	9/16

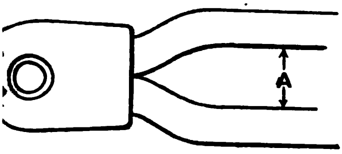
Bond Conductors

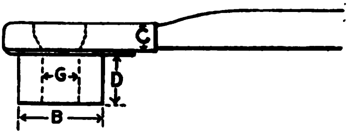
Duplex Parallel Bonds

Size of Bond	Distance Between Conductors A	Unbalanced Bonds						Balanced Bonds		
		Smaller Strand			Larger Strand			No. of Wires Each Strand	Diam. of Each Strand	Capacity of Each Strand
		No. Wires	Diam. Strand	Capacity	No. Wires	Diam. Strand	Capacity			
1/0	¾	...	...	....	...	...	....	19	.28	53,000
2/0	⅞	19	.28	50,000 C.M.	37	.36	86,000 C.M.	37	.32	67,000
3/0	⅞	37	.32	65,000 C.M.	61	.40	105,000 C.M.	37	.36	86,000
4/0	⅞	37	.36	88,000 C.M.	61	.44	125,000 C.M.	61	.40	106,000
300,000 C.M.	⅞	61	.44	125,000 C.M.	91	.51	175,000 C.M.	91	.47	150,000
500,000 C.M.	1	127	.56	210,000 C.M	127	.65	290,000 C.M.	127	.61	250,000

COPPER RAIL BONDS.—*Continued*

CONCEALED RAIL BONDS FOR RAIL WEBS.—*Continued*





STANDARD DIMENSIONS OF CROWN RAIL BONDS.—*Continued*

Equivalents in Millimeters of the Dimensions in the Tables on page 372.)

Bond Terminals

ize of Bond	Outside Diameter B of Stud	Solid Stud Terminals		Tubular Stud Terminals		
		Length of Stud under Head, D	Thickness of Crown or Head, C	Length of Stud under Head, D	Thickness of Crown or Head, C	Diameter of Hole Through Stud, G
	m/m	m/m	m/m	m/m	m/m	m/m
1/0	12.70	19.05	6.35	14.29	6.35	5.08
2/0	15.88	19.05	7.14	14.29	7.14	7.14
3/0	19.05	19.05	7.94	14.29	7.94	8.73
4/0	22.23	19.05	7.94	14.29	7.94	10.32
0,000 C. M.	25.40	19.05	9.55	15.88	9.53	14.29
0,000 C. M.	25.40	19.05	9.53	15.88	9.53	14.29

Bond Conductors

Duplex Parallel Bonds

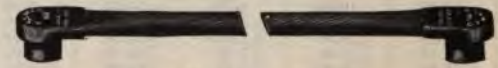
ze of Bond	Distance Between Conductors A	Unbalanced Bonds						Balanced Bonds		
		Smaller Strand			Larger Strand			No. of Wires in Each Strand	Diam. of Each Strand	Capacity of Each Strand
		No. Wires	Diam. Strand	Capacity	No. Wires	Diam. Strand	Capacity			
	m/m		m/m	m/m²		m/m	m/m²		m/m	m/m²
1/0	19.05	...	.....	.....	...	.....	......	19	7.11	26.86
2/0	22.23	19	7.11	25.34	37	9.14	43.58	37	8.13	33.95
3/0	22.23	37	8.13	32.94	61	10.16	53.20	37	9.14	43.58
4/0	22.23	37	9.14	44.59	61	11.18	63.34	61	10.16	53.71
00,000 C.M.	22.23	61	11.18	63.34	91	12.95	88.68	91	11.94	76.00
00,000 C.M.	25.40	127	14.22	106.41	127	16.51	146.95	127	15.49	126.67

COPPER RAIL BONDS.—*Continued*

STANDARD DIMENSIONS OF CROWN RAIL BONDS.—*Continued*

SINGLE STRAND BONDS

Size of Bond	Number of Wires	Diameter Over Strand		Pit Stra Diar De
		Inch	m/m	
1/0	27	.41	10.41	
2/0	37	.45	11.43	
3/0	37	.50	12.70	
4/0	37	.56	14.22	
300,000 C. M.	61	.67	17.02	
500,000 C. M.	91	.85	21.59	



CROWN FLEXIBLE RAIL BOND

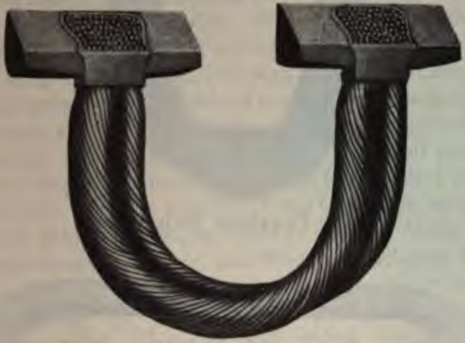
CROWN SOLID RAIL BOND

COPPER RAIL BONDS.—*Continued*

BONDS FOR RAIL HEADS

STEEL TERMINAL FLAME WELD BOND

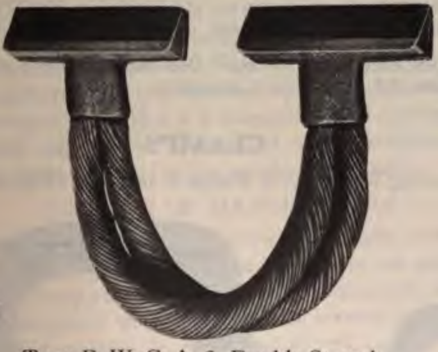
PATENTED



Type F. W. S. A.-2, Double Strand

COPPER TERMINAL FLAME WELD BOND

PATENTED



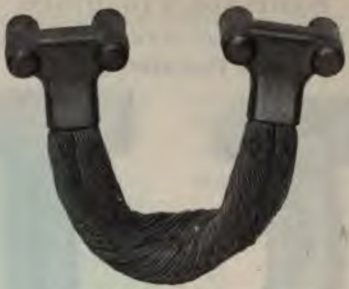
Type F. W. C. A.-2, Double Strand

Designed for application to the head of the rail by use of the oxy-acetylene flame and special flux wire.

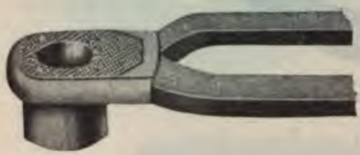
Standard length 7½ inches (190.5 m/m) straight and extended

These bonds can be furnished with single strand, if preferred.

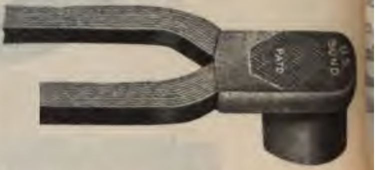
Copper Rail Bonds.—*Continued*



Twin Terminal Rail Bond



TYPE U. P.-2, UNITED STATES BOND
Having tubular terminal studs for pin expansion

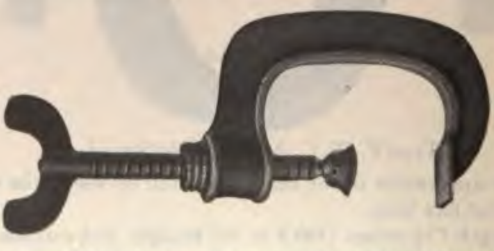


TYPE U. S.-2, UNITED STATES BOND
Having solid studs for compression

For other types and forms of Rail Bonds, see American Steel and Wire Company's illustrated Rail Bond Catalogue.

CLAMPS

For holding Flame Weld Bonds in position while soldering



Clamp No. 84, for all types of Flame Weld Bonds

SOLID WROUGHT STEEL WHEELS

(MANUFACTURED BY CARNEGIE STEEL COMPANY)

We furnish Solid Wrought Steel Wheels for Steam Railway Service, Electrified Steam Railway Service, and Electric Railway Service, and for Mine Locomotives and Industrial and Mining Cars; also a large variety of Wrought Steel Circular Sections, such as Gear Blanks, Crane Track Wheel Blanks, Automobile Fly Wheel Blanks, Turbine Disk Blanks, Locomotive Piston Blanks, Pipe Flange Blanks, Shaft Coupling Blanks, etc., etc., full particulars of which, with drawings of the standard sections and contours, tables showing the actual diameters and circumferences corresponding to the "tape sizes," and other valuable information, are given in a special pamphlet, entitled "Wrought Steel Circular Sections," which will be furnished on request.

On pages 379, 380, 382, 384 and 385 of this Catalogue are given the dimensions of standard Wheels for Steam Railway Service, Motor Car Wheels for Electrified Steam Railway Service, and Wheels for Electric Railway Service. On pages 388 to 400 will be found the standard specifications to which they [illegible] manufactured.

[illegible]cessary Information. Inquiries and orders should be specific, and [illegible]icularly as regards:—

1. Number of Pieces.
2. Drawing Number.
3. Rough Bore.
4. Specifications for Quality and Tolerances.
5. Point of Delivery.

Where inquiries cover sections not shown in this Catalogue or in the special pamphlet "Wrought Steel Circular Sections," a drawing showing exactly what is required and the service for which it is intended should accompany the inquiry. Full and complete information is essential to the intelligent answering of inquiries and execution of orders to the satisfaction of users.

DETAILS OF MANUFACTURE

Weights. Owing to the special character of the forging and rolling processes and to variations in bore, the weights of wheels are not given in the tables which follow. It is only guaranteed that, where maximum weights are stated in specific quotations, such weights will not be exceeded.

Finish. Wherever practicable, steam and electric railway wheels are rolled to a finish, and are machined on rims only when necessary to bring them within the permissible variations in dimensions, or to remove slight surface imperfections.

Where surfaces are to be finish-machined by the user, sufficient excess material beyond the finished dimensions will be allowed by the makers. The illustrations *in the pamphlet and this* Catalogue show finished dimensions.

Solid Wrought Steel Wheels.—*Continued*

Bore. Wheels will be furnished with hubs rough-bored only. Carnegi Steel Company is not equipped to finish-bore hubs or to mount wheels.

Tape Sizes. Carnegie Steel Company uses three tapes for measurement o wheel circumferences. Tape sizes for wheels less than 28 inches in diamete are determined by a Carnegie standard tape with zero at 4′-0″. Tape size for wheels 28 inches and over, with rims less than 5½ inches in width, ar determined by a Carnegie standard tape with zero at 7′-0″. Tape sizes fo wheels 28 inches and over, with nominal rim width 5½ inches or over, ar determined by a Carnegie standard tape based on the Master Car Builders standard tape with zero at 7′-0″.

The three tapes above mentioned are graduated in eighths of an inch; the tape sizes corresponding to the diameters and circumferences are shown in tables in the special pamphlet "Wrought Steel Circular Sections." The range under and over the normal diameter is in accordance with the specifications applicable to the particular class of wheel.

Detailed Drawings. Drawings for any of the sizes of wheels or other wrought steel circular sections manufactured by Carnegie Steel Company will be sent on application.

New Designs. Even slight modifications in the sections shown in the pamphlet may require the preparation of new dies. New designs of sections will be considered only when the number of pieces involved is sufficient to warrant the preparation of new equipment.

In the interest of standardization, however, it is desirable that the number of sizes and designs be kept to a minimum. Quicker deliveries, at lower prices, can be obtained by ordering standard weights and sections.

WHEELS FOR STEAM RAILWAY SERVICE

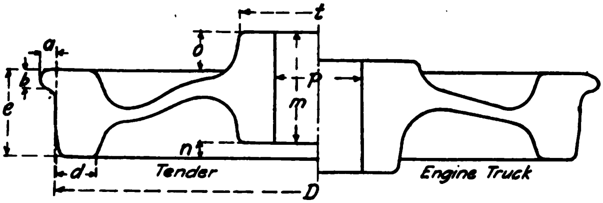
Steam Railway Wheels are classified as to service and appear in the tables and pamphlet in order as follows:—

1. Engine Truck Wheels.
2. Tender Wheels.
3. Passenger Train Car Wheels.
4. Freight Car Wheels.
5. Motor Car Wheels for Electrified Service.

Wheels for these classes of service will be furnished in accordance with American Society for Testing Materials Standard Specifications for Solid Wrought Carbon Steel Wheels for Steam Railway Service, A-57-16 (see pages 388 to 393 of this Catalogue), and to the 1909-Contour of Master Car Builders' Association, for which see the special pamphlet above referred to.

SOLID WROUGHT STEEL WHEELS.—*Continued*

STANDARD WHEELS FOR STEAM RAILWAY SERVICE

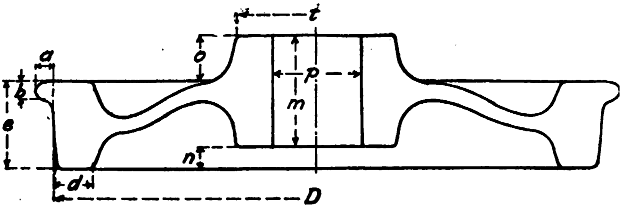


Section No.	Diameter, D		Rim				Hub							
			Width, e		Thickness, d		Diameter, t		Length, m		Projection, o Despression, n			
											Front		Back	
	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m
ENGINE TRUCK WHEELS														
S-1064	36	915	5½	140	2½	63.5	11–16	280–406	7⅛	181	o 15/16	23.8	o 11/16	17.5
S-1063	36	915	5½	140	2½	63.5	11–14	280–356	7⅛	181	o 15/16	23.8	o 11/16	17.5
S-1061	36	915	5½	140	2½	63.5	10–12½	254–318	7⅛	181	o 15/16	23.8	o 11/16	17.5
S-1034	33	838	5½	140	2½	63.5	11–16	280–406	7⅛	181	o 15/16	23.5	o 11/16	17.5
S-1033	33	838	5½	140	2½	63.5	11–14	280–356	7⅛	181	o 15/16	23.8	o 11/16	17.5
S-1031	33	838	5½	140	2½	63.5	10–12½	254–318	7⅛	181	o 15/16	23.8	o 11/16	17.5
S-1011	30	762	5½	140	2½	63.5	10–12½	254–318	7⅛	181	o 15/16	23.8	o 11/16	17.5
TENDER WHEELS														
S-1162	36	915	5½	140	2½	63.5	11	280	7½	191	n 1 3/16	30.2	o 3 3/16	81.0
S-1167	36	915	5½	140	2½	63.5	11	280	7	178	n 15/16	23.8	o 2 7/16	61.9
S-1161	36	915	5½	140	2½	63.5	10	254	7	178	n 15/16	23.8	o 2 7/16	61.9
S-1135	33	838	5½	140	2½	63.5	11	280	7½	191	n 1 3/16	30.2	o 3 3/16	81.0
S-1137	33	838	5½	140	2½	63.5	11	280	7	178	n 15/16	23.8	o 2 7/16	61.9
S-1131	33	838	5½	140	2½	63.5	10	254	7	178	n 15/16	23.8	o 2 7/16	61.9

For **drawings of the above** standard sections, and other information, see pamphlet "Wrought **Steel Circular Sections**" which will be furnished on request.

SOLID WROUGHT STEEL WHEELS.—*Continued*

STANDARD WHEELS FOR STEAM RAILWAY SERVICE.—*Continued*



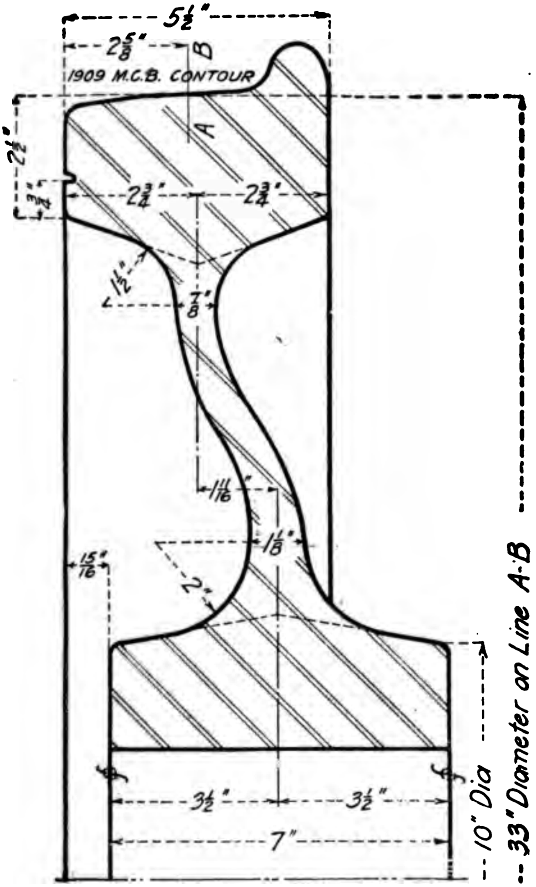
Section No.	Diameter, *D*		Rim				Hub							
			Width, *e*		Thickness, *d*		Diameter, *t*		Length, *m*		Projection, *o* Depression, *n*			
											Front		Back	
	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/
PASSENGER TRAIN CAR WHEELS														
S-1262	36	915	5½	140	2½	63.5	11	280	7½	191	*n* 1 3/16	30.2	*o* 3 3/16	81.
S-1267	36	915	5½	140	2½	63.5	11	280	7	178	*n* 15/16	23.8	*o* 2 7/16	61.
S-1261	36	915	5½	140	2½	63.5	10	254	7	178	*n* 15/16	23.8	*o* 2 7/16	61.
FREIGHT CAR WHEELS														
S-1332	33	838	5½	140	2½	63.5	11	280	7½	191	*n* 1 3/16	30.2	*o* 3 3/16	81.
S-1337	33	838	5½	140	2½	63.5	11	280	7	178	*n* 15/16	23.8	*o* 2 7/16	61.
S-1331	33	838	5½	140	2½	63.5	10	254	7	178	*n* 15/16	23.8	*o* 2 7/16	61.

For drawings of the above standard sections, and other information, see pamphlet "Wrough Steel Circular Sections" which will be furnished on request.

Solid Wrought Steel Wheels.—*Continued*

33" FREIGHT CAR WHEEL

S-1331

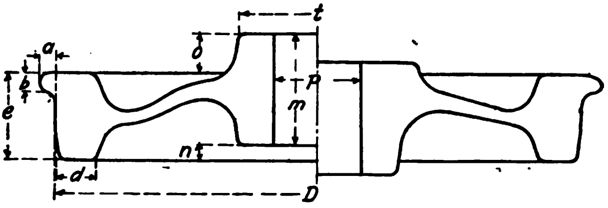


Rough bore as specified. Figures show finished sizes.

Surfaces marked § to be machined.

SOLID WROUGHT STEEL WHEELS.—*Continued*

STANDARD WHEELS FOR ELECTRIFIED STEAM RAILWAY SERVICE



Section No.	Diameter, *D*		Rim				Hub							
			Width, *e*		Thickness, *d*		Diameter, *t*		Length, *m*		Projection, *o* Depression, *n*			
											Front		Back	
	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m
MOTOR CAR WHEELS														
S-1291	42	1067	5½	140	2½	63.5	14	356	8¾	222	*o* 3	76.2	*o* ¼	6.4
	42	1067	5½	140	2½	63.5	11	280	8¾	222	*o* 3	76.2	*o* ¼	6.4
S-1287	38	965	5½	140	2½	63.5	11	280	7	178	*n* ⅛	3.2	*o* 1⅝	41.3
	37	940	5½	140	2½	63.5	10	254	7	178	*n* 15/16	23.8	*o* 2 7/16	61.9
S-1288	36	915	5½	140	2½	63.5	14	356	7¾	197	*o* ⅝	15.9	*o* 1⅝	41.3
	36	915	5½	140	2½	63.5	14	356	7	178	*n* ⅛	3.2	*o* 1⅝	41.3
S-1262	36	915	5½	140	2½	63.5	11	280	7½	191	*n* 1 3/16	30.2	*o* 3 3/16	81.0
S-1267	36	915	5½	140	2½	63.5	11	280	7	178	*n* 15/16	23.8	*o* 2 7/16	61.9
S-1261	36	915	5½	140	2½	63.5	10	254	7	178	*n* 15/16	23.8	*o* 2 7/16	61.9
S-1135	33	838	5½	140	2½	63.5	11	280	7½	191	*n* 1 3/16	30.2	*o* 3 3/16	81.0
S-1137	33	838	5½	140	2½	63.5	11	280	7	178	*n* 15/16	23.8	*o* 2 7/16	61.9
S-1131	33	838	5½	140	2½	63.5	10	254	7	178	*n* 15/16	23.8	*o* 2 7/16	61.9
S-1782	30	762	5½	140	2½	63.5	10	254	7	178	*n* 15/16	23.8	*o* 2 7/16	61.9

Dimensions *m* show the maximum hub lengths; these dimensions may be less than given, but must be specified.

Dimensions *o* show the projections of hub; these dimensions may be changed, but back projection must be specified.

Where section numbers are alike Motor Car Wheels are identical with regular steam railway wheels.

For drawings of the above standard sections, and other information, see pamphlet "Wrought Steel Circular Sections" which will be furnished on request.

SOLID WROUGHT STEEL WHEELS.—*Continued*

WHEELS FOR ELECTRIC RAILWAY SERVICE

Electric Railway Wheels are classified as to service and appear in the tables and pamphlet in order as follows:

1. Standard Wheels for Electric Railway Service.
    a. Wheels for City Service.
    b. Wheels for Suburban and Interurban Service.

The standard wheels for city service are made to standard contours as adopted after conferences with operating officials of electric railway lines and as evidenced by greatest demand. The standard wheels for suburban and interurban service are made to 1907 standard contours of the American Electric Railway Association.

2. Special Wheels for Electric Railway Service.
    a. Wheels for City Service.
    b. Wheels for Suburban and Interurban Service.

While it is desirable, in the interests of economy and prompt deliveries, that electric railway lines should use the standard wheels for electric railway service, Carnegie Steel Company has equipment for the special wheels for electric service (Group 2) and is prepared to consider inquiries for them in case operating conditions make the use of the standard wheels (Group 1) impracticable.

Specifications. Wheels for all these classes of service will be furnished in accordance with American Society for Testing Materials Standard Specifications for Solid Wrought Carbon Steel Wheels for Electric Railway Service, A-25-16 (see pages 394 to 400 of this Catalogue).

Contour of Tread and Flange. In the special pamphlet "Wrought Steel Circular Sections" are shown two standard contours of the American Electric Railway Association:

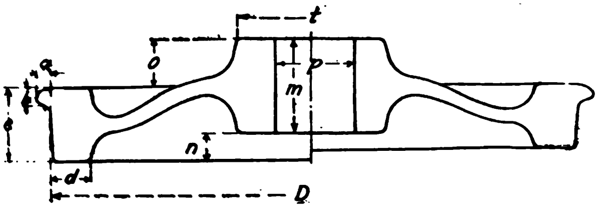
1907 A. E. R. A. Standard $4\frac{3}{16}''$ rim width
1907 A. E. R. A. " $4\frac{11}{16}''$ " "

as also the standard mounting practice with respect to allowance between the track gauge and the wheel gauge. The pamphlet also shows the contours and similar data for standard wheels for city service, adopted after conferences with operating officials of electric railway lines and as evidenced by greatest demand:

1919 Standard for City Service, $3\frac{1}{2}$ in. rim width, $\frac{3}{4}$ in. flange height.
1919 Standard for City Service, $3\frac{1}{2}$ in. rim width, $\frac{5}{8}$ in. flange height.
1919 Standard for City Service, $3\frac{3}{8}$ in. rim width, $\frac{3}{4}$ in. flange height.
1919 Standard for City Service, $3\frac{3}{8}$ in. rim width, $\frac{5}{8}$ in. flange height.

SOLID WROUGHT STEEL WHEELS.—*Continued*

STANDARD WHEELS FOR ELECTRIC SERVICE



Serial No.	Section No.	Diameter		Flange Height a		Flange Thickness, b		Tread Width	
		Ins.	m/m	In.	m/m	Ins.	m/m	Ins.	m/m
WHEELS FOR CITY SERVICE									
42	S-1934	34	864	¾	19.05	1	25.40	2½	63.5
41	S-1924	34	864	¾	19.05	⅞	22.23	2½	63.5
27	S-1933	33	838	¾	19.05	1	25.40	2½	63.5
26	S-1923	33	838	¾	19.05	⅞	22.23	2½	63.5
23	S-1931	31	788	¾	19.05	1	25.40	2½	63.5
22	S-1921	31	788	¾	19.05	⅞	22.23	2½	63.5
15	T-2051	26	661	¾	19.05	1	25.40	2½	63.5
14	T-2047	26	661	¾	19.05	⅞	22.23	2½	63.5
8	T-2050	24	610	¾	19.05	1	25.40	2½	63.5
7	T-2046	24	610	¾	19.05	⅞	22.23	2½	63.5
4	T-2049	22	550	¾	19.05	1	25.40	2½	63.5
3	T-2045	22	550	¾	19.05	⅞	22.23	2½	63.5
2	T-2048	21	534	¾	19.05	1	25.40	2½	63.5
1	T-2044	21	534	¾	19.05	⅞	22.23	2½	63.5
WHEELS FOR SUBURBAN AND INTERURBAN SERVICE									
52	S-1467	36	915	⅞	22.23	1 3/16	30.16	3½	88.9
51	S-1462	36	915	⅞	22.23	1 3/16	30.16	3	76.2
44	S-1447	34	864	⅞	22.23	1 3/16	30.16	3½	88.9
43	S-1444	34	864	⅞	22.23	1 3/16	30.16	3	76.2
28	S-1456	35	889	⅞	22.23	1 3/16	30.16	3	76.2

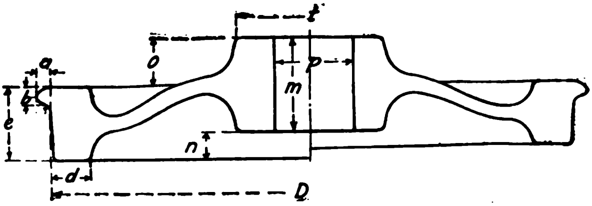
Wheels having ¾" flange height can be furnished ⅞", if specified.

For continuation of the above table, showing dimensions of Rim and Hub, see opposite page.

For drawings of the above standard sections and other information, see pamphlet "Wrought Steel Circular Sections," which will be furnished on request.

SOLID WROUGHT STEEL WHEELS.—*Continued*

STANDARD WHEELS FOR ELECTRIC SERVICE.—*Continued*

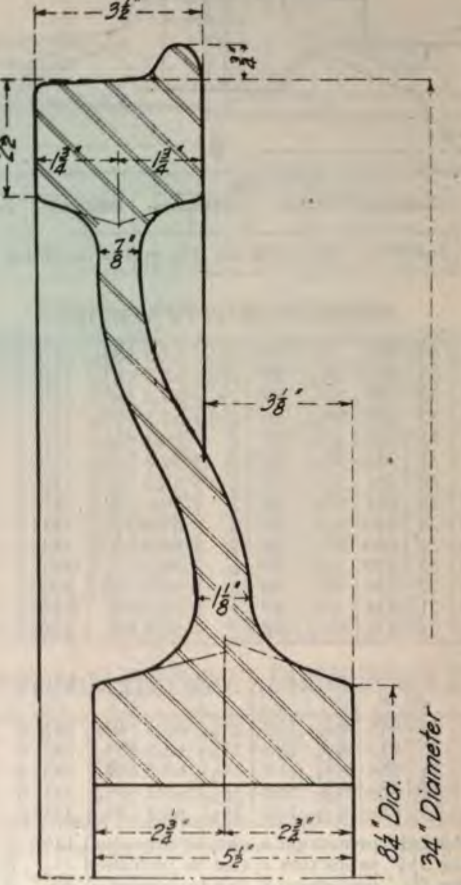


Serial No.	Section No.	Diameter		Rim				Hub					
				Width, *e*		Thickness, *d*		Diameter, *t*		Length *m*		Projection *o*	
		Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m
WHEELS FOR CITY SERVICE													
42	S-1934	34	864	3½	89	2½	63.5	8¼	210	5½	140	3⅛	79.4
41	S-1924	34	864	3⅜	86	2½	63.5	8¼	210	5½	140	3¼	82.6
27	S-1933	33	838	3½	89	2½	63.5	8¼	210	5½	140	3⅛	79.4
26	S-1923	33	838	3⅜	86	2½	63.5	8¼	210	5½	140	3¼	82.6
23	S-1931	31	788	3½	89	2	50.8	8¼	210	5	127	3⅛	79.4
22	S-1921	31	788	3⅜	86	2	50.8	8¼	210	5	127	3¼	82.6
15	T-2051	26	661	3½	89	2	50.8	8¼	210	5	127	3⅛	79.4
14	T-2047	26	661	3⅜	86	2	50.8	8¼	210	5	127	3¼	82.6
8	T-2050	24	610	3½	89	2	50.8	7½	191	5	127	3⅛	79.4
7	T-2046	24	610	3⅜	86	2	50.8	7⅛	181	5	127	3¼	82.6
4	T-2049	22	559	3½	89	2	50.8	7½	191	5	127	3⅛	79.4
3	T-2045	22	559	3⅜	86	2	50.8	7½	191	5	127	3¼	82.6
2	T-2048	21	534	3½	89	2	50.8	7	178	5	127	3⅛	79.4
1	T-2044	21	534	3⅜	86	2	50.8	7	178	5	127	3¼	82.6
WHEELS FOR SUBURBAN AND INTERURBAN SERVICE													
52	S-1467	36	915	4 11/16	119	2½	63.5	9¼	235	6	153	2 15/16	74.6
51	S-1462	36	915	4 3/16	106	2½	63.5	9¼	235	6	153	2 15/16	74.6
44	S-1447	34	864	4 11/16	119	2½	63.5	9¼	235	6	153	2 15/16	74.6
43	S-1444	34	864	4 3/16	106	2½	63.5	9¼	235	6	153	2 15/16	74.6
28	S-1436	33	838	4 3/16	106	2½	63.5	9¼	235	6	153	2 15/16	74.6

Wheels having 2 15/16″ projection *o*, can be furnished 1 15/16″, if specified.
Wheels having 3⅛″ projection *o*, can be furnished 2⅛″, if specified.
Wheels having 3¼″ projection *o*, can be furnished 2¼″, if specified.
For dimensions of Flange and width of Tread, see opposite page.
For drawings of the above standard sections, and other information, see amphlet "Wrought Steel Circular Sections," which will be furnished on request.

SOLID WROUGHT STEEL WHEELS.—*Continued*

TYPICAL 34" CAR WHEEL
CITY SERVICE STANDARD—3½" RIM
S-1934



Rough bore as specified. Figures show finished sizes.

This wheel can be furnished with 2⅛" back projection, if specified.
This wheel can be furnished with flange ⅝" high, if specified.

Solid Wrought Steel Wheels.—*Continued*

MINE LOCOMOTIVE WHEELS

In a mine locomotive, tractive effect is the relation between the dead weight of the locomotive and the amount of pull exerted at the drawbar in the hauling of loads.

It is well established that the tractive effect of a steel wheel on a steel rail is 25 per cent. greater than that of the cast chilled wheel on the same rail (see Peele, Mining Engineers' Handbook, 1918, page 1143). In consequence, to pull the same load a locomotive with solid steel wheels needs to weigh but 80 per cent. as much as the locomotive with cast chilled wheels. This tractive superiority of the steel wheel over the cast chilled wheel increases with the grade of the roadway.

It is extremely desirable in the interest of the locomotive builder and locomotive user that the number of types in mine locomotive wheels be reduced so as to permit the widest possible standardization. The sizes and profiles shown in the pamphlet "Wrought Steel Circular Sections" have been selected after a careful investigation so as to meet a very wide range of requirements. It is believed that by slight modifications these types will fit locomotives in use and that their adoption as standards will materially conduce to simplification of mine locomotive practice.

Any modification in the designs shown which cannot be obtained by a reasonable amount of machine work will require the preparation of new equipment.

Specifications. Wheels for mine locomotives will be furnished in accordance with American Society for Testing Materials Standard Specifications for Solid Wrought Carbon Steel Wheels for Steam Railway Service—A-57-16 (see page 388 to 393 of this Catalogue) with projections of hub subject to locomotive truck wheel tolerances.

INDUSTRIAL AND MINE CAR WHEELS

The wrought steel wheel has distinct advantages for industrial purposes, particularly under heavy loading conditions in yards around mills, blast furnaces, etc., where there are unavoidable accumulations of grit and dirt. It has also like advantages for use under hot metal ladles, ingot cars and like conveyances of metal in heated condition liable to splash.

Owing to the great variety of uses a large degree of standardization is not practicable. The drawings in the pamphlet "Wrought Steel Circular Sections" show sizes for which Carnegie Steel Company has equipment in hand and which experience indicates to be most suitable for ordinary purposes.

Any modification in the designs shown which cannot be obtained by a reasonable amount of machine work will require the preparation of new equipment.

Specifications. Wheels for industrial purposes and mine cars will be furnished in accordance with Carnegie Steel Company Standard Specifications for Solid Wrought Carbon Steel Wheels for Industrial Purposes—July 1, 1919—*copy of which will be furnished on request.*

STANDARD SPECIFICATIONS FOR SOLID WROUGHT CARBON-STEEL WHEELS FOR STEAM RAILWAY SERVICE

SERIAL DESIGNATION: A57–16

ADOPTED 1912, REVISED 1916, BY THE
AMERICAN SOCIETY FOR TESTING MATERIALS,
AFFILIATED WITH THE
INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS

(For the Metric equivalents of the dimensions given in these specifications, refer to the tables on Pages 13 to 28.)

I. MANUFACTURE

Process 1. The steel shall be made by the Open Hearth process.

Discard 2. A sufficient discard shall be made from each ingot to secure freedom from injurious piping and undue segregation.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition 3. The test shall conform to the following requirements as to chemical composition:

	Acid	Basic
Carbon, per cent	0.60—0.80	0.65—0.85
Manganese, per cent . . .	0.55—0.80	0.55—0.80
Phosphorus, per cent	Not over 0.05	Not over 0.05
Sulphur, per cent . .	Not over 0.05	Not over 0.05
Silicon, per cent . . .	0.15—0.35	0.10—0.30

Ladle Analyses 4. An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of the elements specified in Section 3. This analysis shall be made from a test ingot taken during the pouring of the melt. The chemical composition thus determined, together with such identifying records as may be desired, shall be reported to the purchaser or his representative, and shall conform to the requirements specified in Section 3.

Check Analyses 5. An analysis may be made by the purchaser from a wheel representing each melt. The chemical composition thus determined shall conform to the requirements specified in Section 3. A sample may be taken from any one point in the plate, or two samples may be taken, in which case they shall be on radii at right angles to each other. Samples shall not be taken in such a way as to impair the usefulness of the wheel. Drillings for analysis shall be taken by boring entirely through the sample parallel to the axis of the wheel; they shall be

SPECIFICATIONS FOR WHEELS FOR STEAM SERVICE.—*Continued*

clean and free from scale, oil and other foreign substances. All drillings from any one wheel shall be thoroughly mixed together.

III. MATING

Mating

6. The wheels shall be mated as to tape sizes and shipped in pairs.

IV. PERMISSIBLE VARIATIONS IN DIMENSIONS

(See Pages 392 and 393)

Permissible Variations

7. The wheels shall conform to the dimensions specified within the following permissible variations:

FLANGE

(*a*) ***Height of Flange.*** The height of flange shall not be less, but may be ⅛ inch more than that specified.

(*b*) ***Thickness of Flange.*** The thickness of flange shall not vary more than 1/16 inch from that specified.

(*c*) ***Radius of Throat.*** The radius of throat shall not vary more than 1/16 inch from that specified.

RIM

(*d*) ***Thickness of Rim.*** The rim may vary in thickness, but the variation less than that specified shall not exceed 3/16 inch. The thickness of rim shall be measured from the inner edge of the rim to a base line drawn from the intersection of the throat radius and the tread, parallel to the axis of the wheel.

(*e*) ***Width of Rim.*** The width of rim shall not vary more than ⅛ inch from that specified.

(*f*) ***Plane.*** The wheels shall be gauged with a ring gauge placed concentric with and perpendicular to the axis of the wheel. For all points on the back face of the rim equidistant from the center, the variation from the plane of the gauge when so placed shall not exceed 1/16 inch.

(*g*) ***Rotundity.*** The tread shall be gauged with a ring gauge, and the opening between the tread and this gauge at any point shall not exceed 1/16 inch.

(*h*) ***Block Marks on Tread.*** Block marks shall not exceed 1/64 inch in height.

(*i*) ***Tape Sizes.*** The wheels shall not vary more than 9 tapes over nor more than 5 tapes under the size specified.

SPECIFICATIONS FOR WHEELS FOR STEAM SERVICE.—*Continued*

(*j*) *Limit-of-Wear Groove.* When a limit-of-wear groove is specified, its location shall not vary more than ⅛ inch from that specified, and its distance from the inner edge of the rim shall not at any point be less than ¾ inch.

PLATE

(*k*) *Thickness of Plate.* The plate may vary in thickness, but the variation less than that specified shall not exceed $\frac{1}{32}$ inch for each ⅛-inch in the thickness of the plate.

HUB

(*l*) *Diameter of Hub.* The diameter of hub may vary, but the thickness of wall of the finished bored hub shall not be less than 1⅛ inches at any point for bores 7 inches or under in diameter, nor less than 1⅜ inches for bores over 7 inches in diameter, unless otherwise specified. The thickness of wall of the hub shall not vary more than ⅜ inch at any two points on the same wheel.

(*m*) *Length of Hub.* The length of hub shall not vary more than ⅛ inch from that specified.

(*n*) *Depression of Hub.* For car and tender wheels and wheels of similar design, the depression of the hub below the front face of the rim shall not be less, but may be ⅛ inch more than that specified.

(*o*) *Projection of Hub.* For locomotive-truck wheels and wheels of similar design, the projection of the hub beyond the back face of the rim shall not be less, but may be ⅛ inch more than that specified.

BORE

(*p*) *Diameter of Rough Bore.* The diameter of rough bore shall not vary more than $\frac{1}{16}$ inch over nor more than ⅛ inch under that specified. When finished-bore diameter only is specified, the rough-bore diameter shall be made ¼ inch less with the permissible variations specified above.

(*q*) *Black Spots in Bore.* Black spots in rough bore within 2 inches of either face of the hub shall not exceed $\frac{1}{16}$ inch in depth.

(*r*) *Eccentricity of Bore.* The eccentricity between the tread at its center line and the rough bore shall not exceed $\frac{3}{64}$ inch.

SPECIFICATIONS FOR WHEELS FOR STEAM SERVICE.—*Continued*

V. FINISH

Finish

8. (*a*) The wheels shall be free from injurious defects and all have a workmanlike finish.

(*b*) Wheels shall not be offered for inspection if covered ith paint, rust, or any other substance to such an extent as hide defects.

VI. MARKING

Marking

9. (*a*) The name or brand of the manufacturer, date and rial number shall be legibly stamped on each wheel in such way that the wheel may be readily identified.

(*b*) The tape size shall be legibly marked on each wheel.

VII. INSPECTION AND REJECTION

Inspection

10. (*a*) The gauges and tapes used shall be based on Master ar Builders' standards.

(*b*) The inspector representing the purchaser shall have ree entry, at all times while work on the contract of the purhaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the wheels ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the wheels are being furnished in accordance with these specifications. Tests and inspection at the place of manufacture shall be made prior to shipment.

(*c*) The purchaser may make the tests to govern the acceptance or rejection of wheels in his own laboratory or elsewhere. Such tests, however, shall be made at the expense of the purchaser.

(*d*) All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection

11. (*a*) Unless otherwise specified, any rejection based on tests made in accordance with Section 10 (*c*) shall be reported within five working days from the receipt of samples.

(*b*) Wheels which show injurious defects while being inished by the purchaser will be rejected, and the manufacurer shall be notified.

Rehearing

12. Samples tested in accordance with Section 10 (*c*), which epresent rejected wheels, shall be preserved for two weeks om the date of the test report. In case of dissatisfaction ith the results of the tests, the manufacturer may make aim for a rehearing within that time.

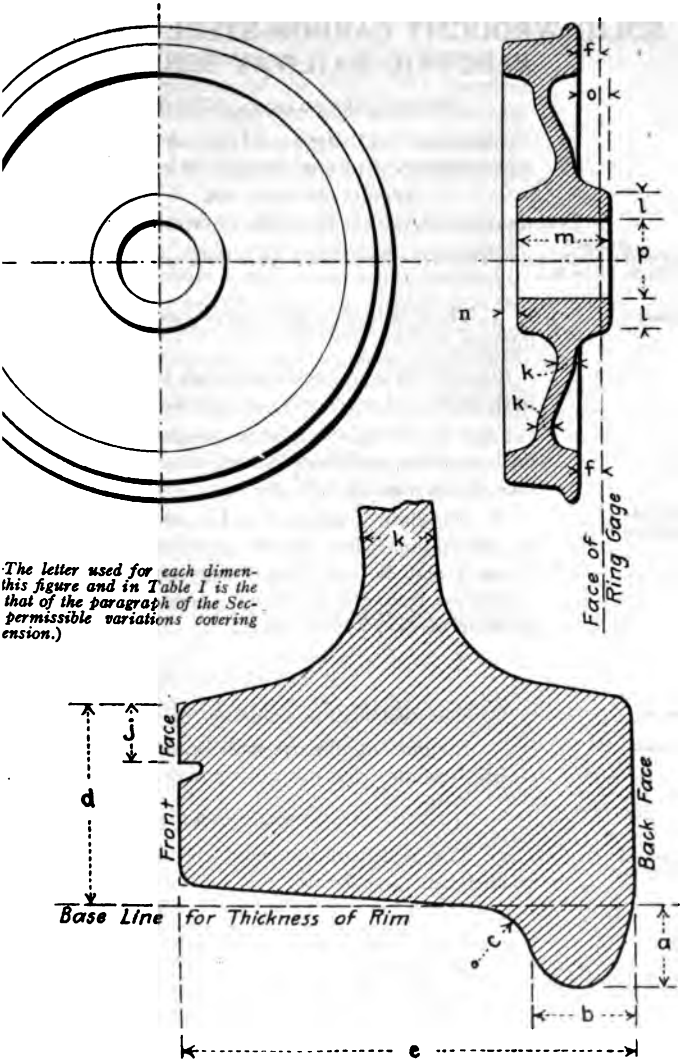
SPECIFICATIONS FOR WHEELS FOR STEAM SERVICE.—*Continued*

TABLE I.—PERMISSIBLE VARIATIONS IN DIMENSIONS OF WROUGHT STE WHEELS FOR STEAM RAILWAY SERVICE.

Dimensions	Permissible Varia in Dimension	
	Over	Un
FLANGE		
(*a*) Height	$\frac{1}{8}$ in.	0
(*b*) Thickness	$\frac{1}{16}$ in.	$\frac{1}{16}$ i
(*c*) Radius of Throat	$\frac{1}{16}$ in.	$\frac{1}{16}$ i
RIM		
(*d*) Thickness, from Inner Edge to Intersection of Throat and Tread	.....	$\frac{1}{16}$ i
(*e*) Width	$\frac{1}{8}$ in.	$\frac{1}{8}$ i
(*f*) Maximum Departure of any Circle on Back Face from Plane	$\frac{1}{16}$ in.	
(*g*) Maximum Departure of Tread from Rotundity	$\frac{1}{16}$ in.	
(*h*) Maximum Height of Block Marks on Tread	$\frac{1}{64}$ in.	
(*i*) Tape Sizes	9	5
(*j*) Limit-of-Wear Groove:		
1. Maximum Departure from Specified Position	$\frac{1}{8}$ in.	
2. Minimum Distance from Inner Edge of Rim	$\frac{3}{4}$ in.	
PLATE		
(*k*) Thickness, Variation for each $\frac{1}{8}$ in. of thickness	.....	$\frac{1}{32}$ i
HUB		
(*l*) 1. Diameter		Limit by W Thick
2. Minimum Thickness of Wall, for Bore 7 in. or under	$1\frac{1}{8}$ in.	
3. Minimum Thickness of Wall, for Bore over 7 in	$1\frac{3}{8}$ in.	
4. Maximum Variation in Thickness of Wall in any One Wheel	$\frac{3}{8}$ in.	
(*m*) Length	$\frac{1}{8}$ in.	$\frac{1}{8}$ i
(*n*) Depression below Front Face of Rim	$\frac{1}{8}$ in.	0
(*o*) Projection beyond Back Face of Rim	$\frac{1}{8}$ in.	0
BORE (If not specified, Rough Bore shall be $\frac{1}{4}$ in. less than Finished Bore)		
(*p*) Diameter of Rough Bore	$\frac{1}{16}$ in.	$\frac{1}{8}$ i
(*q*) Maximum Depth of Black Spots in Rough Bore within 2 in. of End of Bore	$\frac{1}{16}$ in.	
(*r*) Maximum Eccentricity of Rough Bore in Relation to Tread	$\frac{3}{64}$ in.	

NOTE.—The letter used for each dimension in this table and in Fig. 1 is the same as th the paragraph of Section 7 covering that dimension.

SPECIFICATIONS FOR WHEELS FOR STEAM SERVICE.—*Continued*



The letter used for each dimen- this figure and in Table I is the that of the paragraph of the Sec- permissible variations covering ension.)

-Diagram showing points at which the dimensions covered by the specifications are *For the permissible variations in these dimensions see* Table 1 or Section 7.

STANDARD SPECIFICATIONS FOR SOLID WROUGHT CARBON-STEEL WHEELS FOR ELECTRIC RAILWAY SERVICE

SERIAL DESIGNATION: A25-16

ADOPTED 1913, REVISED 1916, BY THE
AMERICAN SOCIETY FOR TESTING MATERIALS
AFFILIATED WITH THE
INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS

(For the Metric equivalents of the dimensions given in these specifications, refer to the tables on Pages 13 to 28.)

Classes

1. These specifications cover two classes of wheels, as follows:

Class A: Wheels furnished rough-bored with hub faced on both sides, and other surfaces as rolled or forged.

Class B: Wheels furnished rough-bored with hubs faced on both sides, and front face of rim, tread, flange, and back face of rim machined.

Basis of Purchase

2. The class of wheel to be furnished shall be agreed upon by the manufacturer and the purchaser. Wheels ordered to Class A may be machined if necessary, but the permissible variations from the dimensions specified shall remain those given in Section 9 for Class A.

I. MANUFACTURE

Process

3. The steel shall be made by the Open Hearth process.

Discard

4. A sufficient discard shall be made from each ingot to secure freedom from injurious piping and undue segregation.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition

5. The steel shall conform to the following requirements as to chemical composition:

	Acid	Basic
Carbon, per cent.....	0.60—0.80	0.65—0.85
Manganese, per cent..	0.55—0.80	0.55—0.80
Phosphorus, per cent..	Not over 0.05	Not over 0.05
Sulphur, per cent....	Not over 0.05	Not over 0.05
Silicon, per cent..	0.15—0.35	0.10—0.30

Ladle Analyses

6. An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of the elements

ecified in Section 5. This analysis shall be made from a test got taken during the pouring of the melt. The chemical mposition thus determined, together with such identifying cords as may be desired, shall be reported to the purchaser his representative, and shall conform to the requirements ecified in Section 5.

Check Analyses

7. An analysis may be made by the purchaser from a heel representing each melt. The chemical composition hus determined shall conform to the requirements specified in ection 5. A sample may be taken from any one point in the late; or two samples may be taken, in which case they shall e on radii at right angles to each other. Samples shall not be aken in such a way as to impair the usefulness of the wheel. Drillings for analysis shall be taken by boring entirely through the sample parallel to the axis of the wheel; they shall be clean and free from scale, oil and other foreign substances. All drillings from any one wheel shall be thoroughly mixed together.

III. MATING

Mating

8. The wheels shall be mated as to tape sizes and shipped in pairs.

IV. PERMISSIBLE VARIATIONS IN DIMENSIONS

(See pages 399 and 400)

Permissible Variations

9. The wheels shall conform to the dimensions specified ithin the following permissible variations:

FLANGE

(*a*) *Height of Flange.* The height of flange shall not ary from that specified more than $\frac{1}{16}$ inch for Class A or $\frac{1}{32}$ ch for Class B wheels.

(*b*) *Thickness of Flange.* The thickness of flange shall t vary from that specified more than $\frac{1}{16}$ inch for Class A or inch for Class B wheels.

SPECIFICATIONS FOR WHEELS FOR ELECTRIC SERVICE.—*Continued*

(*c*) *Radius of Throat.* The radius of throat shall not vary from that specified more than $\frac{1}{16}$ inch for Class A or $\frac{1}{32}$ inch for Class B wheels.

RIM

(*d*) *Thickness of Rim.* The thickness of rim shall no vary more than ¼ inch over nor more than ⅛ inch under th specified. The thickness of rim shall be measured from th inner edge of the rim to a base line drawn from the intersectio of the throat radius and the tread, parallel to the axis of th wheel.

(*e*) *Width of Rim.* The width of rim shall not vary from that specified more than ⅛ inch for Class A or $\frac{1}{16}$ inch for Class B wheels.

(*f*) *Plane.* The wheels shall be gauged with a ring gauge placed concentric with and perpendicular to the axis of the wheel. For all points on the back of the rim equidistant from the center, the variation from the plane of the gauge when so placed shall not exceed $\frac{1}{16}$ inch for Class A or $\frac{1}{32}$ inch for Class B wheels.

(*g*) *Rotundity.* The tread shall be gauged with a ring gauge, and the opening between the tread and this gauge at any point shall not exceed $\frac{1}{16}$ inch for Class A wheels or $\frac{1}{64}$ inch for Class B wheels.

(*h*) *Block Marks on Tread.* Block marks shall not exceed $\frac{1}{64}$ inch in height.

(*i*) *Tape Sizes.* Wheels with treads under 3 inches in width shall not vary more than 6 tapes over nor more than 4 tapes under the size specified. Wheels with treads 3 in. or over in width shall not vary more than 9 tapes over nor more than 5 tapes under the size specified.

(*j*) *Limit-of-Wear Groove.* When a limit-of-wear groove is specified, its location shall not vary more than $\frac{1}{16}$ inch from that specified.

PLATE

(*k*) *Thickness of Plate.* The plate may vary in thickness, but the variation less than that specified shall not exceed $\frac{1}{32}$ inch for each $\frac{1}{8}$ inch in the thickness of the plate.

SPECIFICATIONS FOR WHEELS FOR ELECTRIC SERVICE.—*Continued*

HUB

(*l*) ***Diameter of Hub.*** The diameter of hub shall not e less, but may be ¾ inch more than that specified. The hickness of wall of the finished bored hub shall not be less than inch at any point for bores 6 inches or under in diameter, nor ss than 1¼ inches for bores over 6 inches in diameter, unless therwise specified. The thickness of wall of the hub shall ot vary more than ⅜ inch at any two points on the same wheel.

(*m*) *Length of Hub.* The length of hub shall not vary more than ⅛ inch from that specified.

(*o*) *Projection of Hub.* The projection of the hub beyond the back face of the rim shall not vary more than 1/16 inch from that specified.

BORE

(*p*) *Diameter of Rough Bore.* The diameter of rough bore shall not vary more than 1/16 inch over nor more than ⅛ inch under that specified. When finished-bore diameter only is specified, the rough-bore diameter shall be made ¼ inch less with the permissible variations specified above.

(*q*) *Black Spots in Bore.* Black spots in rough bore within 2 inches of either face of the hub shall not exceed 1/16 nch in depth.

(*r*) *Eccentricity of Bore.* The eccentricity between the ead at its center line and the rough bore shall not exceed ¼ inch.

V. FINISH

Finish

10. (*a*) The wheels shall be free from injurious defects and all have a workmanlike finish.

(*b*) Wheels shall not be offered for inspection if covered ith paint, rust or any other substance to such an extent as hide defects.

SPECIFICATIONS FOR WHEELS FOR ELECTRIC SERVICE.—*Continued*

VI. MARKING

Marking

11. (*a*) The name or brand of the manufacturer, date and serial number, shall be legibly stamped on each wheel in such a way that the wheel may be readily identified.

(*b*) The tape size shall be legibly marked on each wheel

VII. INSPECTION AND REJECTION

Inspection

12. (*a*) The manufacturer shall provide suitable gauges and tapes, which shall conform to the contour and dimensions specified.

(*b*) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the wheels ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the wheels are being furnished in accordance with these specifications. Tests and inspection at the place of manufacture shall be made prior to shipment.

(*c*) The purchaser may make the tests to govern the acceptance or rejection of wheels in his own laboratory or elsewhere. Such tests, however, shall be made at the expense of the purchaser.

(*d*) All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection

13. (*a*) Unless otherwise specified any rejection based on tests made in accordance with Section 12 (*c*) shall be reported within ten working days from receipt of samples.

(*b*) Wheels which show injurious defects while being finished by purchaser will be rejected, and the manufacturer shall be notified.

Rehearing

14. Samples tested in accordance with Section 12(*c*), which represent rejected wheels, shall be preserved for one month from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

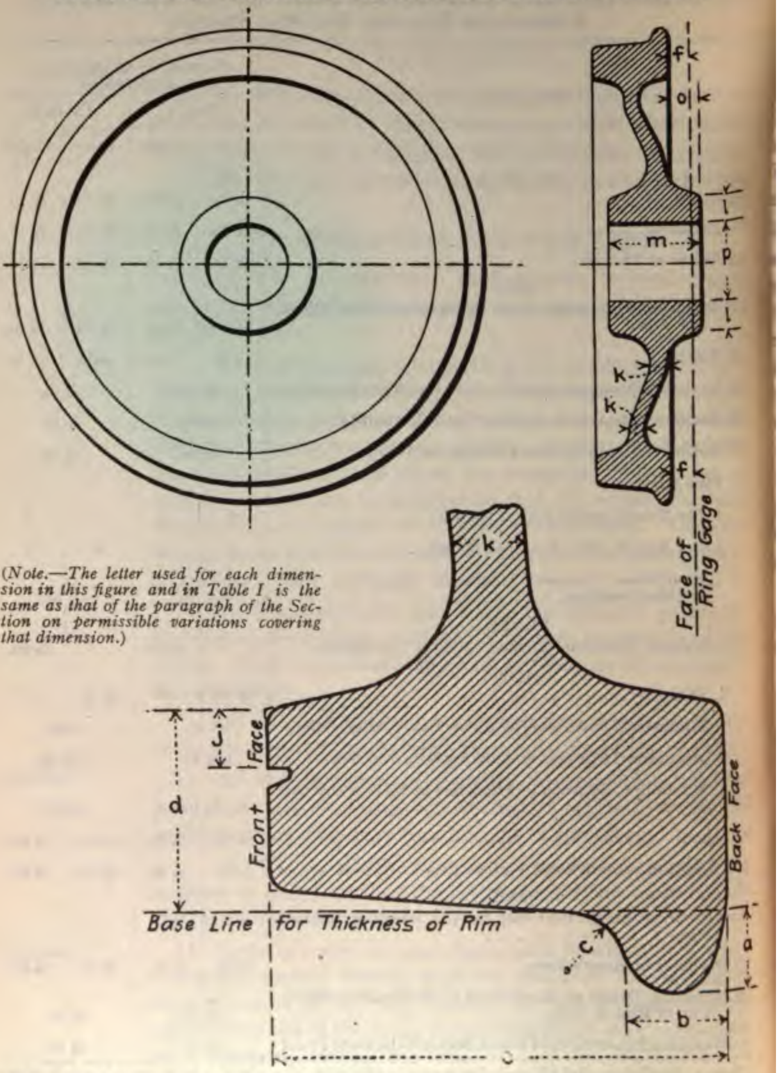
Specifications for Wheels for Electric Service.—*Continued*

Table I.—Permissible Variations in Dimensions of Wrought Steel Wheels for Electric Railway Service

Dimensions	Permissible Variations in Dimensions			
	Class A		Class B	
	Over	Under	Over	Under
FLANGE				
(a) Height	1/16 in.	1/16 in.	1/32 in.	1/32 in.
(b) Thickness	1/16 in.	1/16 in.	1/32 in.	1/32 in.
(c) Radius of Throat	1/16 in.	1/16 in.	1/32 in.	1/32 in.
RIM				
(d) Thickness, from Inner Edge to Intersection of Throat and Tread	¼ in.	⅛ in.	¼ in.	⅛ in.
(e) Width	⅛ in.	⅛ in.	1/16 in.	1/16 in.
(f) Maximum Departure of any Circle on Back Face from Plane	1/16 in.		1/32 in.	
(g) Maximum Departure of Tread from Rotundity	1/16 in.		1/64 in.	
(h) Maximum Height of Block Marks on Tread	1/64 in.		1/64 in.	
(i) Tape Sizes:				
1. For Treads under 3 in. in Width	6	4	6	4
2. For Treads 3 in. or over in Width	9	5	9	5
(j) Limit-of-Wear Groove: Maximum Departure from Specified Position	1/16 in.		1/16 in.	
PLATE				
(k) Thickness, Variation for each ⅛ in. of Thickness	.....	1/32 in.	.....	1/32 in.
HUB				
(l) 1. Diameter	¾ in.	0	¾ in.	0
2. Minimum Thickness of Wall, for Bore 6 in. or under	1 in.		1 in.	
3. Minimum Thickness of Wall, for Bore over 6 in.	1¼ in.		1¼ in.	
4. Maximum Variation in Thickness of Wall in any One Wheel	⅜ in.		⅜ in.	
(m) Length	⅛ in.	⅛ in.	⅛ in.	⅛ in.
(o) Projection beyond Back Face of Rim	1/16 in.	1/16 in.	1/16 in.	1/16 in.
BORE				
If not specified, Rough Bore shall be ¼ in. less than Finished Bore)				
p) Diameter of Rough Bore	1/16 in.	⅛ in.	1/16 in.	⅛ in.
q) Maximum Depth of Black Spots in Rough Bore within 2 in. of End of Bore	1/16 in.		1/16 in.	
r) Maximum Eccentricity of Rough Bore in Relation to Tread	3/64 in.		3/64 in.	

Note.—The letter used for *each dimension in this* table and in Fig. 1 is the same as that of the aragraph *Section 9 covering that dimension.*

SPECIFICATIONS FOR WHEELS FOR ELECTRIC SERVICE.—*Continued*



(*Note.—The letter used for each dimension in this figure and in Table I is the same as that of the paragraph of the Section on permissible variations covering that dimension.*)

FIG. 1. Diagram showing points at which the dimensions covered by the specifications are *measured.* For the permissible variations in these dimensions see Table I or Section 9.

STEEL AXLES AND SIMILAR FORGINGS

MANUFACTURED BY CARNEGIE STEEL COMPANY AND
ILLINOIS STEEL COMPANY

We offer Forged Steel Axles for all kinds of Railway Cars, Engines and Tenders, including freight and passenger Car Axles, Engine Driving, Trailing and Truck Axles, Tender Truck Axles, Motor Axles and various styles of miscellaneous axles.

We do not furnish axles finished ready for the wheels, but either rough turned on journals and wheelseats only, or rough turned all over with the necessary allowance for finishing on the portions requiring it. In the event of flaws or defects of manufacture developing during the process of finishing by the purchasers, our responsibility is limited to replacing or allowing the value (calculated at the net price at which they were invoiced by us) of axles proved, after due investigation by ourselves, to have flaws or defects of manufacture. We accept no responsibility for consequential damages or for expenses incurred in connection with axles having flaws or defects.

Sizes and shapes other than those shown on the following pages, and weighing not less than 300 lbs. (136 kilos) each, and of not less than 3½ inches (89 m/m) rough turned diameter at any point can be furnished to order in quantities of not less than 200 axles of one shape and size.

Requests for quotations should be accompanied by the fullest possible information as to the buyer's requirements, which should include the following particulars:

1. Number of pieces.
2. Design or size. If one of our standard sizes, state the Drawing Number (see tables pages 405 and 406). If not of our standard sizes, we should have full dimensioned drawings, showing all sizes (stating whether dimensions are rough or finished) and giving limits of weight where specified.
3. Specifications for quality. If not to one of the standard specifications printed on pages 407 to 419 of this catalogue, full specifications, covering chemical and physical requirements and tests, should be furnished.
4. Workmanship.
5. Inspection. We should be advised whose inspection will govern, as in making any estimate of the time in which we can promise delivery we must take into consideration the time necessary to notify the inspector and to enable him to reach the works and perform the inspection.
6. Point to which delivery is to be made.

STEEL AXLES AND SIMILAR FORGINGS.—*Continued*

DESIGNS

Blue prints or sketches should be submitted with inquiries or orders, if the designs of axles wanted do not conform to the standards mentioned below.

Car and Tender Axles.—Standard designs of steel axles for passenger and freight equipment cars adopted by the Master Car Builders' Association are shown on page 405. These designs have also been adopted by the American Railway Master Mechanics' Association for tender axles.

Engine Truck and Driving Axles.—There are no adopted standards for these types. It can be said in general that all sizes can be furnished without difficulty.

Electric Motors and Street Car Axles.—The standard designs for motor axles adopted by the American Electric Railway Association are shown on page 406.

Miscellaneous street car axles vary greatly in dimensions, and there are no official standards.

Miscellaneous Forgings.—Complete details for such forgings as shafts, arch bars, crank pins, piston rods and connecting rods, must be furnished with every inquiry or order, as it is impossible otherwise to determine whether shop equipment, designed for the manufacture of axles, is adapted to the production of particular forgings; the maximum diameter suited to the equipment is about 16¾ inches (425 m/m), and the maximum weight 10,000 pounds (4536 kilos).

SPECIFICATIONS

The following specifications, printed in full, beginning on page 407, are recognized standards, and satisfactory to the mills.

A. S. T. M.—Specifications of the American Society for Testing Materials, Serial Designation A-18-18, Standard Specifications for Carbon Steel and Alloy Steel Forgings.

A. S. T. M.—Specifications of the American Society for Testing Materials, Serial Designation A-21-18, Standard Specifications for Carbon Steel Car and Tender Axles.

STEEL AXLES AND SIMILAR FORGINGS.—*Continued*

The following specifications are also satisfactory and may be found in the amphlet "Steel Axles and Similar Forgings" which will be furnished on equest.

A19-18. Standard Specifications for Quenched-and-Tempered Carbon Steel Axles, Shafts, and other Forgings for Locomotives and Cars.

A20-16. Standard Specifications for Carbon Steel Forgings for Locomotives.

M. C. B.—Specifications for Steel Axles, for Passenger and Freight Equipment, adopted by the Master Car Builders' Association in 1899 as recommended practice, and made standard in 1914, and revised in 1916 and 1918.

Special Specifications.—Provided the requirements are satisfactory, any specifications other than the above will be accepted and should be submitted for consideration.

Alloy Steels.—Axles and forgings of alloy steel, such as nickel steel, nickel-chrome steel, and chrome-vanadium steel, can be made either according to our own specifications or according to special specifications, if satisfactory.

HEAT TREATMENT

The mills are equipped to furnish axles and forgings, annealed or quenched-and-tempered, in accordance with any satisfactory specification. The Carnegie Steel Company's experience with the heat treatment of steel has been extensive, not only in connection with the manufacture of axles, but of other steel products also, and the mill practice now followed in their special heat-treating plant is founded upon this experience as well as upon theory. The heat-treating equipment is modern and scientific in all details and the work is personally supervised by experienced metallurgists. The best of facilities for accurate testing are provided and every precaution is taken to insure the actual meeting of the requirements of the specification in the finished product.

WORKMANSHIP

Turning.—Untreated and annealed axles may be furnished "smooth-forged only," "rough-turned on journals and wheel seats," or "rough-turned all over," at customer's option. Quenched-and-tempered axles will only be furnished "rough-turned all over."

Steel Axles and Similar Forgings.—*Continued*

Untreated and annealed forgings are furnished "smooth-forged only" or "rough-turned all over," at customer's option, while quenched-and-tempered forgings will only be furnished "rough-turned all over."

Cutting, Centering and Straightening.—All axles are centered with 60-degree centers and lathe-cut to length with a variation of ⅛ inch (3.175 m/m) over to nothing under the length specified. If necessary, they are straightened on gag press before cutting off or centering, and require no further straightening, cutting off, or centering before finishing.

Boring.—Many specifications, especially those for quenched-and-tempered axles, require that the larger sizes shall be bored longitudinally through the center, the American Society for Testing Materials, Specification A 19-18, specifying that all forgings over 7 inches (177.80 m/m) in diameter shall be so bored before quenching. We are equipped to furnish axles and forgings with either a 2-inch (50.80 m/m) or 3-inch (76.20 m/m) bore.

Special Workmanship.—Special workmanship other than indicated above may be submitted for consideration.

MARKING

Unless otherwise specified, all axles are stamped with maker's name, heat number, and date of manufacture. Special marking, to conform to a particular specification, is frequently done, but such special marking should be submitted for consideration and approval before orders are placed.

For further particulars, see special pamphlet "Steel Axles and Similar Forgings" which will be furnished on request.

STEEL AXLES AND SIMILAR FORGINGS.—*Continued*

MASTER CAR BUILDERS' ASSOCIATION STANDARD AXLES

ma- n xle	Drawing No.	Journals		Center		Guaranteed Weight					
						Smooth Forged Only		Rough Turned Journals and Wheel Seats		Rough Turned All Over	
		Ins.	m/m	Ins.	m/m	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
A	H-2500	3¾x 7	95x178	4¼	108	470	214	452	205	414	188
B	H-2501	4¼x 8	108x203	4¾	121	579	263	552	251	519	236
C	H-2502	5 x 9	127x229	5⅜	137	754	342	734	333	689	313
D	H-2503	5½x10	140x254	5⅞	149	922	419	849	385	825	375
E	H-2504	6 x11	152x279	6 7/16	164	1115	506	1032	469	1002	455

xle "A" is designed to carry 7500 pounds (3402 kilos) on each journal, or 00 pounds (6804 kilos) per axle.

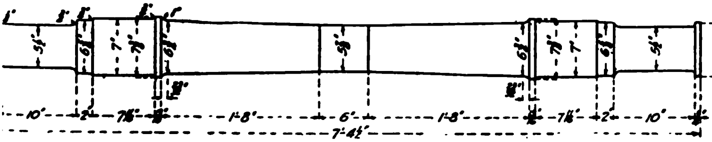
xle "B" designed to carry 11,000 pounds (4990 kilos) on each journal, or 00 pounds (9979 kilos) per axle.

xle "C" is designed to carry 15,500 pounds (7031 kilos) on each journal, or 00 pounds (14,061 kilos) per axle.

xle "D" is designed to carry 19,000 pounds (8618 kilos) on each journal, or 00 pounds (17,237 kilos) per axle.

xle "E" is designed to carry 25,000 pounds (11,340 kilos) on each journal, or 00 pounds (22,680 kilos) per axle.

AXLE "D," DRAWING NO. H-2503, 5½" x 10" (140 m/m x 254 m/m), M. C. B. AND A. R. M. M. STANDARD, CAPACITY 38,000 POUNDS



imensions show finished sizes. Ends are lathe-cut and centered with enters.

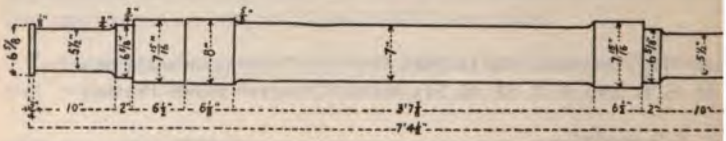
r drawings and details of other standard sizes, see special pamphlet "Steel s and Similar Forgings."

STEEL AXLES AND SIMILAR FORGINGS.—*Continued*

MOTOR TRUCK AXLES, AMERICAN ELECTRIC RAILWAY ASSOCIATION STA

Designation of Axle	Drawing No.	Journals		Center		Capacity per Axle		Guarant Weigh Rough T All Ov
		Inches	m/m	Ins.	m/m	Lbs.	Kilos	Lbs.
E 1	H-3100	3¼x 6	83x152	3½	89	9000	4082	265
E 2	H-3101	3¼x 6	83x152	4	102	13000	5897	318
E 3	H-3102	3¾x 7	95x178	4½	114	16000	7258	389
E 4	H-3103	3¾x 7	95x178	4½	114	15000	6804	405
E 5	H-3104	3¾x 7	95x178	4½	114	14000	6350	420
E 6	H-3105	4¼x 8	108x203	5	127	18000	8165	541
E 7	H-3106	4¼x 8	108x203	5½	140	22000	9979	592
E 8	H-3107	5 x 9	127x229	6	152	27000	12247	761
E 9	H-3108	5 x 9	127x229	6½	165	31000	14062	824
E 10	H-3109	5½x10	140x254	7	178	38000	17237	1007

MOTOR TRUCK AXLE E 10, DRAWING NO. H-3109, 5½" x 10"
(140 m/m x 254 m/m),
A. E. R. A. STANDARD, CAPACITY 38,000 POUNDS



Dimensions show finished sizes. Ends are lathe-cut and centered 60° centers.

For drawings and details of other standard sizes, see special pamphlet Axles and Similar Forgings."

AMERICAN SOCIETY FOR TESTING MATERIALS

STANDARD SPECIFICATIONS FOR CARBON-STEEL CAR AND TENDER AXLES

SERIAL DESIGNATION A21–18

ADOPTED 1901; REVISED, 1905, 1913, 1914, 1918

(For the Metric equivalents of the dimensions and weights given in these specifications, refer to the tables on pages 13 to 28.)

Material Covered

1. These specifications cover axles up to and including those 6½ inches in diameter at the center. Axles over 6½ inches in diameter at the center shall not be subject to the drop test, but may be purchased under the Standard Specifications for Carbon-Steel and Alloy-Steel Forgings (Serial Designation: A 18) of the American Society for Testing Materials.

I. MANUFACTURE

Process

2. The steel shall be made by the open-hearth process.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition

3. The steel shall conform to the following requirements as to chemical composition:

Carbon	0.35–0.55	per cent
Manganese	not over 0.70	" "
Phosphorus	" " 0.05	" "
Sulphur	" " 0.06	" "

Ladle Analyses

4. An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of the elements pecified in sec. 3. This analysis shall be made from a test ngot taken during the pouring of the melt. The chemical omposition thus determined shall be reported to the purhaser or his representative and shall conform to the requirements specified in sec. 3.

Check Analyses

5. An analysis may be made by the purchaser from an axle epresenting each melt. The chemical composition thus etermined shall conform to the requirements specified in ec. 3. Drillings for analysis may be taken from the axle or rom a full-size prolongation of the same, at any point midway etween the center and surface.

A. S. T. M. SPECIFICATIONS FOR CARBON-STEEL CAR AND TENDER AXLES.—*Continued*

III. PHYSICAL PROPERTIES AND TESTS

Drop Tests

6. (*a*) The test axle shall be so placed on supports, 3 ft. apart, that the tup will strike it midway between the ends. It shall stand without fracture five blows from a tup of 2240 lbs. falling from a height H, such that H, in feet, equals the square of the diameter of the axle at the center in inches, $H = d^2$. The axle shall be turned through 180 degrees after the first and third blows.

(*b*) The permanent set produced by the first blow shall not exceed that given by the following formulas, in which L = length of axles, in inches and D = diameter of axle at center, in inches.

For axles over 65 inches in length:

$$\left(\frac{L}{1.9d}-\frac{d}{2}\right)+\tfrac{1}{2}\text{ inch}\ldots\ldots\ldots\ldots\ldots(1)$$

For axles 65 inches or under in length:

$$\left(\frac{L}{1.9d}-\frac{d}{2}\right)+1\text{ inch}\ldots\ldots\ldots\ldots\ldots(2)$$

(*c*) The Master Car Builders' Association and the American Railway Master Mechanics' Association have adopted four standard sizes of axles, the requirements for which, based on the above formula (1), are given in the following table:

Size of Journal, Inches	Diameter of Axle at Center, Inches	Length of Axle, Inches	Height of Drop, Feet	Number of Blows	Maximum Permanent Set, Inches
4¼ x 8	4¾	84¼	22½	5	7½
5 x 9	5⅜	86½	29	5	6¼
5½ x 10	5⅞	88½	34½	5	5½
6 x 11	6 1/16	90¾	41½	5	4¾

(*d*) The maximum permanent set is the difference between the distance from a straight edge to the middle point of the axle, measured before the first blow, and the distance

A. S. T. M. SPECIFICATIONS FOR CARBON-STEEL CAR AND TENDER AXLES.—*Continued*

measured in the same manner after the blow. The straight edge shall rest only on the collars or the ends of the axle.

(*e*) The temperature of the test axle shall be between 40° and 120° F.

Drop-Test Machine

7. The anvil of the drop-test machine shall be supported on 12 springs, shall be free to move in a vertical direction, and shall weigh 17,500 pounds. The radii of the striking face of the tup and of the supports shall be 5 inches.

Number of Tests

8. One drop-test shall be made from each melt. Not less than 30 axles shall be offered from any one melt, unless otherwise agreed upon by the manufacturer and the purchaser.

IV. WORKMANSHIP AND FINISH

Workmanship

9. The axles shall conform to the sizes and shapes specified by the purchaser. When centered, 60-degree centers with clearance drilled for points shall be used.

Finish

10. The axles shall be free from injurious defects and shall have a workmanlike finish.

V. MARKING

Marking

11. Identification marks shall be legibly stamped on each axle. The purchaser shall indicate the location of such identification marks.

VI. INSPECTION AND REJECTION

Inspection

12. (*a*) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the axles ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the axles are being furnished in accordance with these specifications.. Tests and inspection at the place of manufacture shall be made prior to shipment.

(*b*) The purchaser may make the chemical tests to govern the acceptance or rejection of the axles in his own

A. S. T. M. SPECIFICATIONS FOR CARBON-STEEL CAR AND TENDER AXLES.—*Continued*

laboratory or elsewhere. Such tests, however, shall be m at the expense of the purchaser.

(*c*) All tests and inspection shall be so conducted as to interfere unnecessarily with the operation of the works.

Rejection

13. (*a*) Unless otherwise specified, any rejection base tests made in accordance with sec. 12 (*b*) shall be repo within five working days from the receipt of samples.

(*b*) Axles which show injurious defects while b finished by the purchaser will be rejected, and the ma facturer shall be notified.

Rehearing

14 Samples tested in accordance with sec. 12 (*b*), w represent rejected axles, shall be preserved for two weeks f the date of the test report. In case of dissatisfaction with results of the tests, the manufacturer may make claim f rehearing within that time.

AMERICAN SOCIETY FOR TESTING MATERIALS

STANDARD SPECIFICATIONS FOR CARBON-STEEL AND ALLOY-STEEL FORGINGS

SERIAL DESIGNATION A18-18

ADOPTED, 1901; REVISED, 1905, 1914, 1916, 1918

For the Metric equivalents of the dimensions and weights given in these specifications, refer he tables on Pages 13 to 28.)

Classes

1. (*a*) These specifications cover the various classes of bon-steel and alloy-steel forgings now commonly used and t covered by other existing specifications of the American ciety for Testing Materials.

(*b*) The purposes for which these classes are frequently ed are as follows:

Class A, for forgings which may be welded or case-hardened;

Class B, for mild steel forgings for structural purposes, for inor ship fittings, etc.;

Class C, for mild steel forgings for structural purposes, for hips, etc.;

Classes D, E, F, G, H and I, for various machinery forgings, hoice depending upon design and upon the stresses and services to be imposed.

Classes K, L and M, for various machinery forgings, choice depending upon design and upon the stresses and services to be imposed, and upon the character of machining operations to be done.

I. MANUFACTURE

Process

2. The steel may be made by the Open Hearth or any other process approved by the purchaser.

Discard

3. A sufficient discard shall be made from each ingot to secure freedom from injurious piping and undue segregation.

Prolongations for Tests

4. The manufacturer and the purchaser shall agree upon forgings on which a prolongation for test purposes shall be provided.

A. S. T. M. SPECIFICATIONS FOR CARBON-STEEL AND ALLOY-STEEL FORGINGS.—*Continued*

Boring

5. If boring is specified, the diameter of the hole shall be at least 20 per cent. of the maximum outside diameter or thickness of the forging, exclusive of collars and flanges.

Heat Treatment

6. Heat treatment, if required, shall consist of either annealing or quenching and tempering, as specified.

(*a*) For annealing, the forgings shall be allowed to become cold after forging. They shall then be uniformly reheated to the proper temperature to refine the grain (a group thus reheated being known as an "annealing charge"), and allowed to cool uniformly.

(*b*) For quenching and tempering, the forgings shall be allowed to become cold after forging. They shall then be uniformly reheated to the proper temperature to refine the grain (a group thus reheated being known as a "quenching charge"), and quenched in some medium under substantially uniform conditions for each quenching charge. Finally, they shall be uniformly reheated to the proper temperature for tempering or "drawing back" (a group thus reheated being known as a "tempering charge"), and allowed to cool uniformly.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition

7. (*a*) The steel shall conform to the following requirements as to chemical composition:

Elements Considered		Class A	Classes B, C, D, E, F, G	Classes H, I	Classes K and L	Class M
Manganese, %		0.30—0.55	0.40—0.80	0.40—0.80	....	....
Phosphorus, Not over, %	Acid	0.05	0.05	0.04	0.05	0.04
	Basic	0.05	0.05	0.04	0.04	0.04
Sulphur, Not over, %		0.05	0.05	0.05	0.05	0.05
Nickel, Not under, %			....	3.00	....	....

(*b*) The composition of alloy-steel, other than phosphorus and sulphur, to be used in forgings of classes K, L and M, shall be agreed upon by the manufacturer and the purchaser.

A. S. T. M. SPECIFICATIONS FOR CARBON-STEEL AND ALLOY-STEEL FORGINGS.—*Continued*

8. An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of carbon, manganese and the elements specified in Section 7. This analysis shall be made from a test ingot taken during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative and shall conform to the requirements specified in Section 7. **Ladle Analyses**

9. An analysis may be made by the purchaser from a forging representing each melt. The chemical composition thus determined shall conform to the requirements specified in Section 7. Drillings for analysis may be taken from the forging or from a full-size prolongation of the same, at any point midway between the center and surface of solid forgings, and at any point midway between the inner and outer surfaces of the wall of bored forgings; or turnings may be taken from a test specimen. **Check Analyses**

III. PHYSICAL PROPERTIES AND TESTS

10. (*a*) The forgings shall conform to the requirements as to tensile properties specified in Tables I, II and III. **Tension Tests**

(*b*) The classification by size of the forging shall be determined by the specified diameter or thickness which governs the size of the prolongation from which the test specimen is taken.

(*c*) The yield point shall be determined by the drop of the beam of the testing machine.

(*d*) The elastic limit called for by these specifications shall be determined by an extensometer reading to 0.0002 inch. The extensometer shall be attached to the specimen at the gauge marks and not to the shoulders of the specimen nor to any part of the testing machine. When the specimen is in place and the extensometer attached, the testing machine shall be operated so as to increase the load on the specimen at a uniform rate. The observer shall watch the elongation of the specimen as shown by the extensometer and shall note, for this determination, the load at which the rate

A. S. T. M. SPECIFICATIONS FOR CARBON-STEEL AND ALLOY-STEEL FORGINGS.—*Continued*

of elongation shows a sudden increase. The extenson shall then be removed from the specimen, and the test tinued to determine the tensile strength.

(*e*) Tests of forgings shall be made only after final t ment.

Tension Test Specimens

11. (*a*) Tension test specimens shall be taken from a size prolongation of any forging. For forgings with large or collars the prolongation may be of the same cross-se as that of the forging back of the large end or collar. S mens may be taken from the forging itself with a hollow if approved by the purchaser.

(*b*) The axis of the specimen shall be located at point midway between the center and surface of solid forg and at any point midway between the inner and outer sur of the wall of bored forgings, and shall be parallel to the of the forging in the direction in which the metal is drawn out.

(*c*) Test specimens shall conform to the dimen shown in Fig. 1. The ends shall be of a form to fit the ho of the testing machine in such a way that the load sha axial.

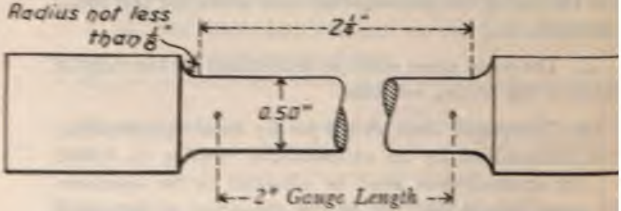


Fig. 1

NOTE.—The gauge length, parallel portions and fillets shall be as s but the ends may be of any form which will fit the holders of the t machine.

Number of Tests

12. Unless otherwise specified by the purchaser, tests be made as follows:

A. S. T. M. SPECIFICATIONS FOR CARBON-STEEL AND ALLOY-STEEL FORGINGS.—*Continued*

(*a*) For untreated forgings, one tension test shall be ade from each melt.

(*b*) For annealed forgings, one tension test shall be ade from each annealing charge. If more than one melt is presented in an annealing charge, one tension test shall be ide from each melt.

(*c*) For quenched and tempered forgings, one tension st shall be made from each tempering charge. If more than e quenching charge is represented in a tempering charge, e tension test shall be made from each quenching charge. more than one melt is represented in a quenching charge, e tension test shall be made from each melt.

(*d*) If more than one class of forgings by size is repreited in any lot, one tension test from a forging of each class size shall be made as specified in Sections 10 and 11.

(*e*) If any test specimen shows defective machining or velops flaws, it may be discarded and another specimen bstituted.

(*f*) If the percentage of elongation of any tension test ecimen is less than that specified in Section 10 (*a*) and any rt of the fracture is more than ¾ inch from the center of gauge length, as indicated by scribe scratches marked on specimen before testing, a retest shall be allowed.

Retests

13. If the results of the physical tests of any test lot of gings do not conform to the requirements specified, the inufacturer may re-treat such lot one or more times, and ests shall be made as specified in Section 12.

IV. WORKMANSHIP AND FINISH

Workmanship

14. The forgings shall conform to the sizes and shapes ecified by the purchaser. When centered, 60 degree centers th clearance drilled for points shall be used.

Finish

15. The forgings shall be free from injurious defects and ill have a workmanlike finish.

A. S. T. M. SPECIFICATIONS FOR CARBON-STEEL AND ALLOY-STEEL FORGINGS.—*Continued*

V. MARKING

Marking

16. Identification marks shall be legibly stamped on each forging and on each test specimen. The purchaser shall indicate the location of such identification marks.

VI. INSPECTION AND REJECTION

Inspection

17. (*a*) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the forgings ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the forgings are being furnished in accordance with these specifications. Tests and inspection at the place of manufacture shall be made prior to shipment.

(*b*) The purchaser may make the tests to govern the acceptance or rejection of the forgings in his own laboratory or elsewhere. Such tests, however, shall be made at the expense of the purchaser.

(*c*) Tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection

18. (*a*) Unless otherwise specified, any rejection based on tests made in accordance with Section 17 (*b*) shall be reported within five working days from the receipt of samples.

(*b*) Forgings which show injurious defects while being finished by the purchaser will be rejected, and the manufacturer shall be notified.

Rehearing

19. Samples tested in accordance with Section 17 (*b*), which represent rejected forgings, shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

A. S. T. M. SPECIFICATIONS FOR CARBON-STEEL AND ALLOY-STEEL FORGINGS.—*Continued*

TABLE I.—TENSILE PROPERTIES (CLASSES A TO F, INCLUSIVE)

FOR FORGINGS WHOSE MAXIMUM OUTSIDE DIAMETER OR OVER-ALL THICKNESS IS NOT OVER 20 INCHES

CLASS	SIZE Outside Diameter or Over-all Thickness	Tensile Strength, min. (except Class A), Lbs. per Sq. In.	Yield Point, min., Lbs. per Sq. In.	Elongation in 2 in., min., per cent.		Reduction of Area, min., per cent.	
				Inverse Ratio	Not Under	Inverse Ratio	Not Under
A UNTREATED	All sizes......	47 000 to 60 000	0.5 tens. str.	$\frac{1\,500\,000}{\text{Tens. str.}}$	..	$\frac{2\,500\,000}{\text{Tens. str.}}$	..
B UNTREATED	Not over 12 in.	60 000	0.5 tens. str.	$\frac{1\,550\,000}{\text{Tens. str.}}$	22	$\frac{2\,400\,000}{\text{Tens. str.}}$	35
	Over 12 to 20 in., inclusive..	60 000	0.5 tens. str.	$\frac{1\,480\,000}{\text{Tens. str.}}$	21	$\frac{2\,220\,000}{\text{Tens. str.}}$	32
C ANNEALED	Not over 12 in.	60 000	0.5 tens. str.	$\frac{1\,700\,000}{\text{Tens. str.}}$	25	$\frac{2\,700\,000}{\text{Tens. str.}}$	38
	Over 12 to 20 in., inclusive..	60 000	0.5 tens. str.	$\frac{1\,600\,000}{\text{Tens. str.}}$	24	$\frac{2\,520\,000}{\text{Tens. str.}}$	36
D UNTREATED	Not over 8 in.	75 000	0.5 tens. str.	$\frac{1\,600\,000}{\text{Tens. str.}}$	18	$\frac{2\,200\,000}{\text{Tens. str.}}$	24
	Over 8 to 12 in., inclusive..	75 000	0.5 tens. str.	$\frac{1\,500\,000}{\text{Tens. str.}}$	17	$\frac{2\,000\,000}{\text{Tens. str.}}$	22
	Over 12 to 20 in., inclusive..	75 000	0.5 tens. str.	$\frac{1\,400\,000}{\text{Tens. str.}}$	16	$\frac{1\,800\,000}{\text{Tens. str.}}$	20
E ANNEALED	Not over 8 in.	75 000	0.5 tens. str.	$\frac{1\,800\,000}{\text{Tens. str.}}$	20	$\frac{2\,800\,000}{\text{Tens. str.}}$	33
	Over 8 to 12 in., inclusive..	75 000	0.5 tens. str.	$\frac{1\,725\,000}{\text{Tens. str.}}$	19	$\frac{2\,640\,000}{\text{Tens. str.}}$	31
	Over 12 to 20 in., inclusive..	75 000	0.5 tens. str.	$\frac{1\,650\,000}{\text{Tens. str.}}$	18	$\frac{2\,400\,000}{\text{Tens. str.}}$	29
F ANNEALED	Not over 8 in.	80 000	0.5 tens. str.	$\frac{1\,800\,000}{\text{Tens. str.}}$	20	$\frac{2\,800\,000}{\text{Tens. str.}}$	32
	Over 8 to 12 in., inclusive..	80 000	0.5 tens. str.	$\frac{1\,725\,000}{\text{Tens. str.}}$	19	$\frac{2\,640\,000}{\text{Tens. str.}}$	30
	Over 12 to 20 in., inclusive.	80 000	0.5 tens. str.	$\frac{1\,650\,000}{\text{Tens. str.}}$	18	$\frac{2\,400\,000}{\text{Tens. str.}}$	28

A. S. T. M. SPECIFICATIONS FOR CARBON-STEEL AND ALLOY-STEEL FORGINGS.—*Continued*

TABLE II.—TENSILE PROPERTIES (CLASSES G, H AND I)

CLASS	SIZE	Tensile Strength, Min., Lbs. per Sq. In.	Elastic Limit, Min., Lbs. per Sq. In.	Elongation in 2 in., Min., Per Cent.		Reduction of Area, Min., Per Cent.	
				Inverse Ratio	Not Under	Inverse Ratio	No Und
FOR FORGINGS WHOSE MAXIMUM OUTSIDE DIAMETER OR THICKNESS IS NOT OVER 10 INCH WHEN SOLID, AND NOT OVER 20 INCHES WHEN BORED							
G QUENCHED AND TEMPERED	Up to 4 in. in outside diameter or thickness, 2-in. max. wall	90 000	55 000	$\frac{2\,100\,000}{\text{Tens. str.}}$	20.5	$\frac{4\,000\,000}{\text{Tens. str.}}$	39
	Over 4 to 7 in. in outside diameter or thickness, 3½-in. max. wall	85 000	50 000	$\frac{2\,000\,000}{\text{Tens. str.}}$	20.5	$\frac{3\,800\,000}{\text{Tens. str.}}$	39
	Over 7 to 10 in. in outside diameter or thickness, 5-in. max. wall	85 000	50 000	$\frac{1\,900\,000}{\text{Tens. str.}}$	19.5	$\frac{3\,600\,000}{\text{Tens. str.}}$	37
	Outside diameter or thickness not over 20 in., 5 to 8-in. wall	82 500	48 000	$\frac{1\,800\,000}{\text{Tens. str.}}$	19	$\frac{3\,400\,000}{\text{Tens. str.}}$	36
FOR FORGINGS WHOSE MAXIMUM OUTSIDE DIAMETER OR OVER-ALL THICKNESS IS NOT OVER 20 INCHES							
H NICKEL STEEL, ANNEALED	Outside diameter or over-all thickness not over 12 in.	80 000	50 000	$\frac{2\,000\,000}{\text{Tens. str.}}$	22	$\frac{3\,600\,000}{\text{Tens. str.}}$	40
	Outside diameter or over-all thickness over 12 to 20 in., inclusive	80 000	50 000	$\frac{1\,900\,000}{\text{Tens. str.}}$	21	$\frac{3\,400\,000}{\text{Tens. str.}}$	38
FOR FORGINGS WHOSE MAXIMUM OUTSIDE DIAMETER OR THICKNESS IS NOT OVER 10 INCHES WHEN SOLID, AND NOT OVER 20 INCHES WHEN BORED							
I NICKEL STEEL QUENCHED AND TEMPERED	Up to 4 in. in outside diameter or thickness, 2-in. max. wall	100 000	70 000	$\frac{2\,200\,000}{\text{Tens. str.}}$	20	$\frac{4\,500\,000}{\text{Tens. str.}}$	41
	Over 4 to 7 in. in outside diameter or thickness, 3½-in. max. wall	100 000	65 000	$\frac{2\,100\,000}{\text{Tens. str.}}$	20	$\frac{4\,300\,000}{\text{Tens. str.}}$	41
	Over 7 to 10 in. in outside diameter or thickness, 5-in. max. wall	90 000	60 000	$\frac{2\,000\,000}{\text{Tens. str.}}$	20	$\frac{4\,100\,000}{\text{Tens. str.}}$	41
	Outside diameter or thickness not over 20 in., 5 to 8-in. wall	85 000	55 000	$\frac{1\,900\,000}{\text{Tens. str.}}$	20	$\frac{3\,900\,000}{\text{Tens. str.}}$	41

A. S. T. M. SPECIFICATIONS FOR CARBON-STEEL AND ALLOY-STEEL FORGINGS.—*Continued*

TABLE III.—TENSILE PROPERTIES (CLASSES K, L AND M)

ORGINGS WHOSE MAXIMUM OUTSIDE DIAMETER OR THICKNESS IS NOT OVER 10 INCHES WHEN SOLID, AND NOT OVER 20 INCHES WHEN BORED

LASS	SIZE	Tensile Strength, Lbs. per Sq. In.	Elastic Limit, Min., Lb. per Sq. In.	Elongation in 2 in., Min., Per Cent.	Reduction of Area Min., Per Cent.
K, LOY EEL, CHED ND ERED	Up to 2 in. in outside diameter or thickness, 1-in. max. wall........	95 000–115 000	70 000	20	50
	Over 2 to 4 in. in outside diameter or thickness, 2-in. max. wall.......	90 000–110 000	65 000	20	50
	Over 4 to 7 in. in outside diameter or thickness, 3½-in. max. wall.....	90 000–110 000	65 000	20	50
	Over 7 to 10 in. in outside diameter or thickness, 5 in. max. wall...	90 000–110 000	65 000	20	50
	Outside diameter or thickness not over 20 in., 5 to 8-in. wall.....	85 000–105 000	60 000	20	50
L LOY EEL, NCHED ND PERED	Up to 2 in. in outside diameter or thickness, 1-in. max. wall.......	105 000–125 000	80 000	20	50
	Over 2 to 4 in. in outside diameter or thickness, 2-in. max. wall.......	100 000–120 000	75 000	20	50
	Over 4 to 7 in. in outside diameter or thickness, 3½-in. max. wall......	100 000–120 000	75 000	20	50
	Over 7 to 10 in. in outside diameter or thickness, 5-in. max. wall...	100 000–120 000	75 000	18	45
	Outside diameter or thickness not over 20-in., 5 to 8-in. wall.....	95 000–115 000	70 000	18	45
M LOY EEL, CHED ND ERED	Up to 2-in. in outside diameter or thickness, 1-in. max. wall.......	Minimum 125 000	105 000	16	50
	Over 2 to 4 in. in outside diameter or thickness, 2-in. max. wall.......	115 000	95 000	16	45
	Over 4 to 7 in. in outside diameter or thickness, 3½-in. max. wall.....	110 000	85 000	16	45
	Over 7 to 10 in. in outside diameter or thickness, 5-in. max. wall...	100 000	75 000	18	45
	Outside diameter or thickness not over 20-in., 5 to 8-in. wall.....	100 000	70 000	18	45

STANDARD SPECIFICATIONS FOR BOILER AND FIREBOX STEEL FOR LOCOMOTIVES

SERIAL DESIGNATION: A30-18

ADOPTED 1901; REVISED 1909, 1912, 1913, 1914, 1916, 1918 BY THE
AMERICAN SOCIETY FOR TESTING MATERIALS
AFFILIATED WITH THE
INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS

(For the Metric equivalents of the dimensions and weights given in these specifications, refe to the tables on Pages 13 to 28.)

Grades

1. These specifications cover two grades of steel for boilers for locomotives, namely: flange and firebox.

I. MANUFACTURE

Process

2. The steel shall be made by the Open Hearth process.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition

3. The steel shall conform to the following requirements as to chemical composition:

		Flange	Firebox
Carbon		....	0.12–0.25%
Manganese		0.30–0.60%	0.30–0.60%
Phosphorus	Acid	Not over 0.05%	Not over 0.04%
	Basic	Not over 0.04%	Not over 0.035%
Sulphur		Not over 0.05%	Not over 0.04%

Ladle Analyses

4. An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of the elements specified in Section 3. This analysis shall be made from a test ingot taken during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, and shall conform to the requirements specified in Section 3.

Check Analyses

5. An analysis may be made by the purchaser from a broken tension test specimen representing each plate as rolled. The chemical composition thus determined shall conform to the requirements specified in Section 3.

III. PHYSICAL PROPERTIES AND TESTS

Tension Tests

6. (*a*) The material shall conform to the following requirements as to tensile properties:

	Flange	Firebox
Tensile strength, lbs. per sq. in.	55 000–65 000	52 000–62 000
Yield point, min., lb. per sq. in.	0.5 tens. str.	0.5 tens. str.
Elongation in 8-in., min., per cent.	$\frac{1\ 500\ 000}{\text{Tens. str.}}$	$\frac{1\ 500\ 000}{\text{Tens. str.}}$

(See Section 7)

SPECIFICATIONS FOR BOILER AND FIREBOX STEEL FOR LOCOMOTIVES
Continued

(*b*) The yield point shall be determined by the drop of the beam of the testing machine.

Modifications in Elongation

7. (*a*) For material over ¾ inch in thickness, a deduction of 0.5 from the percentages of elongation specified in Section 6 (*a*) shall be made for each increase of ⅛ inch in thickness above ¾ inch.

(*b*) For material ¼ inch or under in thickness, the elongation shall be measured on a gauge length of 24 times the thickness of the specimen.

Bend Tests

8. (*a*) The test specimen shall bend cold through 180 degrees without cracking on the outside of the bent portion, as follows: For material 1 inch or under in thickness, around a pin the diameter of which is equal to the thickness of the specimen; and for material over 1 inch in thickness, around a pin the diameter of which is equal to twice the thickness of the specimen.

Homogeneity Tests

9. For firebox steel, a sample taken from a broken tension test specimen shall not show any single seam or cavity more than ¼ inch long, in either of the three fractures obtained in the test for homogeneity, which shall be made as follows:

The specimen shall be either nicked with a chisel or grooved on a machine, transversely, about $\frac{1}{16}$ inch deep, in three places about 2 inches apart. The first groove shall be made 2 inches from the square end; each succeeding groove shall be made on the opposite side from the preceding one. The specimen shall then be firmly held in a vise, with the first groove about ¼ inch above the jaws, and the projecting end broken off by light blows of a hammer, the bending being away from the groove. The specimen shall be broken at the other two grooves in the same manner. The object of this test is to open and render visible to the eye any seams due to failure to weld up or to interposed foreign matter, or any cavities due to gas bubbles in the ingot. One side of each fracture shall be examined and the lengths of the seams and cavities determined, a pocket lens being used if necessary.

Test Specimens

10. (*a*) Tension test specimens shall be taken longitudinally from the bottom of the finished rolled material, and bend test specimens shall be taken transversely from the middle of the

SPECIFICATIONS FOR BOILER AND FIREBOX STEEL FOR LOCOMOTIVES
Continued

top of the finished rolled material. The longitudinal test spec mens shall be taken in the direction of the longitudinal axis the ingot, and the transverse test specimens at right angles that axis.

(*b*) Tension and bend test specimens shall be of the fu thickness of material as rolled, and shall be machined to th form and dimensions shown in Figure 1, except that bend te specimens may be machined with both edges parallel.

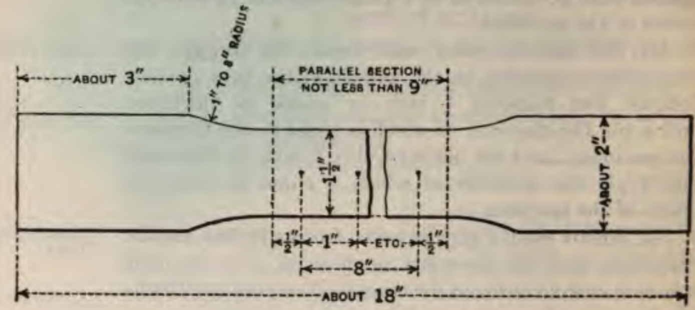


Figure 1

Number of Tests

11. (*a*) One tension and one bend test shall be made from each plate as rolled.

(*b*) If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

(*c*) If the percentage of elongation of any tension test specimen is less than that specified in Section 6 (*a*) and any part of the fracture is outside the middle third of the gauge length, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

IV. PERMISSIBLE VARIATIONS IN WEIGHT AND THICKNESS

Permissible Variations

12. The thickness of each plate shall not vary more than 0.01 inch under that ordered.

The overweight of each lot[1] in each shipment shall not ex ceed the amount given in Table I. One cubic inch of rolle steel is assumed to weigh 0.2833 pound.

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[1] The term "lot" applied to Table I means all of the plates of each grou width and group thickness.

SPECIFICATIONS FOR BOILER AND FIREBOX STEEL FOR LOCOMOTIVES
Continued

TABLE I.—PERMISSIBLE OVERWEIGHTS OF PLATES ORDERED TO THICKNESS

ORDERED THICKNESS, INCHES	PERMISSIBLE EXCESS IN AVERAGE WEIGHTS PER SQUARE FOOT OF PLATES FOR WIDTHS GIVEN, EXPRESSED IN PERCENTAGES OF NOMINAL WEIGHTS									ORDERED THICKNESS, INCHES
	Under 48″	48 to 60″ excl.	60 to 72″ excl.	72 to 84″ excl.	84 to 96″ excl.	96 to 108″ excl.	108 to 120″ excl.	120 to 132″ excl.	132 or over	
Under ⅛	9	10	12	14	..	..	..	..	..	Under ⅛
⅛ to 3/16 excl.	8	9	10	12	..	..	..	..	..	⅛ to 3/16 excl.
3/16 to ¼ excl.	7	8	9	10	12	..	..	..	..	3/16 to ¼ excl.
¼ to 5/16 excl.	6	7	8	9	10	12	14	16	19	¼ to 5/16 excl.
5/16 to ⅜ excl.	5	6	7	8	9	10	12	14	17	5/16 to ⅜ excl.
⅜ to 7/16 excl.	4.5	5	6	7	8	9	10	12	15	⅜ to 7/16 excl.
7/16 to ½ excl.	4	4.5	5	6	7	8	9	10	13	7/16 to ½ excl.
½ to ⅝ excl.	3.5	4	4.5	5	6	7	8	9	11	½ to ⅝ excl.
⅝ to ¾ excl.	3	3.5	4	4.5	5	6	7	8	9	⅝ to ¾ excl.
¾ to 1 excl.	2.5	3	3.5	4	4.5	5	6	7	8	¾ to 1 excl.
1 or over	2.5	2.5	3	3.5	4	4.5	5	6	7	1 or over

V. FINISH

Finish

13. The finished material shall be free from injurious defects and shall have a workmanlike finish.

VI. MARKING

Marking

14. (*a*) The name or brand of the manufacturer, melt or slab number, grade, and lowest tensile strength for its grade specified in Section 6 (*a*), shall be legibly stamped on each plate. The melt or slab number shall be legibly stamped on each test specimen.

SPECIFICATIONS FOR BOILER AND FIREBOX STEEL FOR LOCOMOTIVES
Continued

(*b*) When specified on the order, plates shall be match marked as defined in Paragraph (*c*) so that the test specimens representing them may be identified. When more than one plate is sheared from a single slab or ingot each shall be match marked so that they may all be identified with the test specimen representing them.

(*c*) Each match mark shall consist of two overlapping circles each not less than 1½ inches in diameter, placed upon the shear lines, and made by separate impressions of a single-circle steel die.

(*d*) Match-marked coupons shall match with the sheets represented and only those which match properly shall be accepted.

VII. INSPECTION AND REJECTION

Inspection

15. The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection

16. (*a*) Unless otherwise specified, any rejection based on tests made in accordance with Section 5 shall be reported within five working days from the receipt of samples.

(*b*) Material which shows injurious defects subsequent to its acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

Rehearing

17. Samples tested in accordance with Section 5, which represent rejected material, shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

STANDARD SPECIFICATIONS FOR BOILER RIVET STEEL

SERIAL DESIGNATION: A31-14

ADOPTED 1901; REVISED 1909, 1912, 1913, 1914 BY THE
AMERICAN SOCIETY FOR TESTING MATERIALS
AFFILIATED WITH THE
INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS

(For the Metric equivalents of the dimensions and weights given in these specifications, refer o the tables on Pages 13 to 28.)

A. REQUIREMENTS FOR ROLLED BARS

I. MANUFACTURE

Process

1. The steel shall be made by the Open Hearth process.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition

2. The steel shall conform to the following requirements as to chemical composition:

Manganese	0.30–0.50	per cent.
Phosphorus	Not over 0.04	per cent.
Sulphur	Not over 0.045	per cent.

Ladle Analyses

3. An analysis of each melt of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, phosphorus and sulphur. This analysis shall be made from a test ingot taken during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, and shall conform to the requirements specified in Section 2.

Check Analyses

4. Analyses may be made by the purchaser from finished bars representing each melt. The chemical composition thus determined shall conform to the requirements specified in Section 2.

III. PHYSICAL PROPERTIES AND TESTS

Tension Tests

5. (*a*) The bars shall conform to the following requirements as to tensile properties:

Tensile strength, lbs. per sq. in.	45 000–55 000
Yield point, min., lb. per sq. in.	0.5 tens. str.
Elongation in 8-in., min., per cent	$\frac{1\,500\,000}{\text{Tens. str.}}$ but need not exceed 30 per cent.

SPECIFICATIONS FOR BOILER RIVET STEEL.—*Continued*

(*b*) The yield point shall be determined by the drop of the beam of the testing machine.

Bend Tests

6. (*a*) *Cold-bend Tests.* The test specimen shall bend cold through 180 degrees flat on itself without cracking on the outside of the bent portion.

(*b*) *Quench-bend Tests.* The test specimen, when heated to a light cherry red as seen in the dark (not less than 1200 degrees Fahrenheit), and quenched at once in water the temperature of which is between 80 degrees and 90 degrees Fahrenheit, shall bend through 180 degrees flat on itself without cracking on the outside of the bent portion.

Test Specimens

7. Tension and bend test specimens shall be of the full-size section of bars as rolled.

Number of Tests

8. (*a*) Two tension, two cold-bend, and two quench-bend tests shall be made from each melt, each of which shall conform to the requirements specified.

(*b*) If any test specimen develops flaws, it may be discarded and another specimen substituted.

(*c*) If the percentage of elongation of any tension test specimen is less than that specified in Section 5 (*a*) and any part of the fracture is outside the middle third of the gauge length, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

IV. PERMISSIBLE VARIATIONS IN DIAMETER

Permissible Variations

9. The diameter of each bar shall not vary more than 0.01 inch from that specified.

V. WORKMANSHIP AND FINISH

Workmanship

10. The finished bars shall be circular within 0.01 inch.

Finish

11. The finished bars shall be free from injurious defects and shall have a workmanlike finish.

VI. MARKING

Marking

12. Rivet bars shall, when loaded for shipment, be properly separated and marked with the name or brand of the manufacturer and the melt number for identification. The melt number shall be legibly marked on each test specimen.

SPECIFICATIONS FOR BOILER RIVET STEEL.—*Continued*

VII. INSPECTION AND REJECTION

Inspection

13. The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the bars ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the bars are being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection

14. (*a*) Unless otherwise specified, any rejection based on tests made in accordance with Section 4 shall be reported within five working days from the receipt of samples.

(*b*) Bars which show injurious defects subsequent to their acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

Rehearing

15. Samples tested in accordance with Section 4, which represent rejected bars, shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the test, the manufacturer may make claim for a rehearing within that time.

B. REQUIREMENTS FOR RIVETS[1]

VIII. PHYSICAL PROPERTIES AND TESTS

Tension Tests

16. The rivets, when tested, shall conform to the requirements as to tensile properties specified in Section 5, except that the elongation shall be measured on a gauge length not less than four times the diameter of the rivet.

Bend Tests

17. The rivet shank shall bend cold through 180 degrees flat on itself, as shown in Figure 1, without cracking on the outside of the bent portion.

Flattening Tests

18. The rivet head shall flatten, while hot, to a diameter 2½ times the diameter of the shank, as shown in Fig. 2, without cracking at the edges.

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[1] NOTE.—When supplying bars for the manufacture of rivets we do not guarantee tests on the finished rivets.

SPECIFICATIONS FOR BOILER RIVET STEEL.—*Continued*

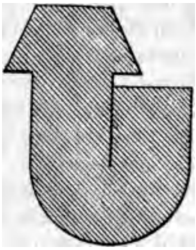

FIG. 1.

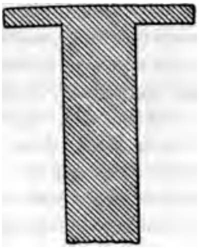

FIG. 2.

Number of Tests

19. (*a*) When specified, one tension test shall be made from each size in each lot of rivets offered for inspection.

(*b*) Three bend and three flattening tests shall be made from each size in each lot of rivets offered for inspection, each of which shall conform to the requirements specified.

IX. WORKMANSHIP AND FINISH

Workmanship

20. The rivets shall be true to form, concentric, and shall be made in a workmanlike manner.

Finish

21. The finished rivets shall be free from injurious defects.

X. INSPECTION AND REJECTION

Inspection

22. The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the rivets ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the rivets are being furnished in accordance with these specifications. All tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection

23. Rivets which show injurious defects subsequent to their acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

LOCOMOTIVE TUBES

STANDARD SPECIFICATIONS FOR LAP-WELDED AND SEAMLESS STEEL BOILER TUBES, BOILER FLUES, SUPERHEATER PIPES, SAFE ENDS, AND ARCH TUBES FOR LOCOMOTIVES

As Revised* Jointly 1916, by the American Railway Master Mechanics' Association and the American Society for Testing Materials.

National Tube Company, Specification No. 1-E of December 1, 1916, for Locomotive Tubes (Superseding Specification No. 1-C of December 1, 1913, and No. 1-D of September 1, 1914)

I. MANUFACTURE

Process

1. The steel shall be made by the Open-Hearth process.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition

2. The steel shall conform to the following requirements as to chemical composition:

Carbon	0.08—0.18 per cent.
Manganese	0.30—0.50 per cent.
Phosphorus	Not over 0.04 per cent.
Sulphur	Not over 0.045 per cent.

Check Analyses

3. (*a*) Analyses of two tubes in each lot of 250 or less may be made by the purchaser. The chemical composition thus determined shall conform to the requirements specified in Section 2. Drillings for analyses shall be taken from several points around each tube.

(*b*) If the analysis of only one tube does not conform to the requirements specified, analyses of two additional tubes from the same lot shall be made, each of which shall conform to the requirements specified.

III. PHYSICAL PROPERTIES AND TESTS

Flange Tests

4. (*a*) For all tubes, except superheater pipes, a test specimen not less than 4 inches in length shall have a flange turned over at right angles to the body of the tube without showing cracks or flaws. This flange as measured from the outside of the tube, shall be ⅜ inch wide for tubes 2½ inches or under in outside diameter, and ½ inch wide for tubes over 2½ inches in outside diameter.

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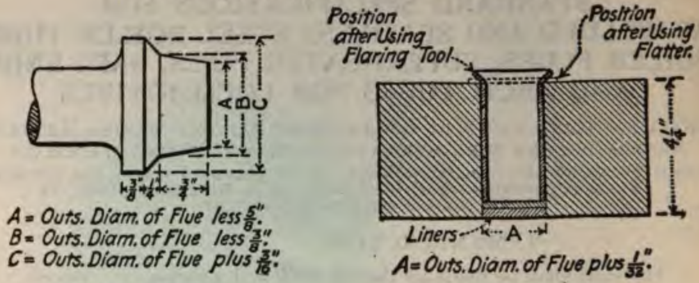
*The American Railway Master Mechanics' Association's specification differs slightly in form from the above, but the substance is the same.

STANDARD SPECIFICATIONS FOR LOCOMOTIVE TUBES.—*Continued*

(*b*) In making the flange test, it is recommended th the flaring tool and die block shown in Fig. 1, be used.


Position after Using Flaring Tool
Position after Using Flatter.
A
B
C
3/8"
1/4"
3/4"
4 1/4"
Liners
A
A = Outs. Diam. of Flue less 5/8".
B = Outs. Diam. of Flue less 3/8".
C = Outs. Diam. of Flue plus 3/16".
A = Outs. Diam. of Flue plus 1/32".

Flaring Tool.

Die Block.

Fig. 1

Flattening Tests

5. (*a*) For all tubes, except superheater pipes, a test specimen 4 inches in length shall stand flattening or hammering until the inside of the walls are in contact, without cracking at the edges or elsewhere. For lap-welded tubes, care shall be taken that the weld is not located at the point of maximum bending.

(*b*) For superheater pipes, a test specimen 4 inches in length shall stand flattening by pressure or hammering until the distance between the inside of the walls is equal to twice the thickness of the material, without cracking at the edges or elsewhere.

Crush Tests

6. (*a*) For all tubes except superheater pipes, a test specimen 2½ inches in length shall stand crushing longitudinally until the outside folds are in contact, without showing cracks or flaws.

(*b*) For superheater pipes, a test specimen 2½ inches in length shall stand crushing longitudinally down to 1¼ inches without showing cracks or flaws.

Hydrostatic Tests

7. Tubes under 5 inches in diameter shall stand an internal hydrostatic pressure of 1,000 pounds per square inch; and tubes 5 inches or over in diameter shall stand an internal hydrostatic pressure of 800 pounds per square inch.

Test Specimens

8. (*a*) Test specimens shall consist of sections cut from tubes selected by the inspector representing the purchaser from the lot offered for shipment. They shall be smooth on the ends and free from burrs.

(*b*) All specimens shall be tested cold.

STANDARD SPECIFICATIONS FOR LOCOMOTIVE TUBES.—*Continued*

Number of Tests

9. One flange, one flattening and one crush test shall be made from each of two tubes in each lot of 250 or less. Each tube shall be subjected to the hydrostatic test.

Retests

10. If the results of the physical tests of only one tube from any lot do not conform to the requirements specified in Sections 4, 5 or 6, retests of two additional tubes from the same lot shall be made, each of which shall conform to the requirements specified.

IV. STANDARD WEIGHTS

Standard Weights

11. The standard weights for tubes of various outside diameters and thicknesses are as indicated in Table I.

TABLE I

LAP-WELDED AND SEAMLESS STEEL BOILER TUBES
Including Safe Ends, Arch Tubes and Large Boiler Tubes

Thickness		WEIGHT IN POUNDS PER FOOT OF LENGTH Outside Diameter in Inches													
nches	Nearest B.W.G. or Fraction	1¾	1⅞	2	2¼	2½	3	3½	4	4½	5	5¼	5⅜	5½	6
.095	13	1.679	1.806	1.932	2.186	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.110	12	1.926	2.073	2.220	2.514	2.807	3.395	.....	.....	.....	.....	.....	.....	.....	.....
.125	11	2.169	2.336	2.503	2.836	3.170	3.838	4.505	.....	.....	.....	.....	.....	.....	.....
.135	10	2.328	2.508	2.688	3.049	3.409	4.130	4.851	5.572	.....	.....	.....	.....	.....	.....
.150	9	2.563	2.763	2.963	3.364	3.764	4.565	5.366	6.167	6.968	7.769	8.170	8.370	8.570	9.371
.156	5/32	.....	.....	.....	.....	3.905	4.738	5.571	6.404	7.237	8.070	8.487	8.695	8.903	9.736
.165	8	.....	.....	.....	.....	4.114	4.995	5.877	6.758	7.639	8.520	8.960	9.181	9.401	10.282
.180	7	.....	.....	.....	.....	4.460	5.421	6.382	7.343	8.304	9.266	9.746	9.987	10.227	11.188
.187	3/16	.....	.....	.....	.....	.....	5.618	6.616	7.615	8.613	9.612	10.111	10.361	10.611	11.609

SMALL SUPERHEATER PIPES
Seamless Only

Thickness		WEIGHT IN POUNDS PER FOOT OF LENGTH Outside Diameter in Inches											
nches	Nearest B.W.G. or Fraction	5/8	11/16	3/4	13/16	7/8	15/16	1	1¼	1⅜	1 7/16	1½	1⅝
.095	13	0.537	0.601	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.109	12	.....	.....	0.746	0.818	.....	.....	.....	.....	.....	.....	.....	.....
.120	11	.....	.....	.....	.....	0.967	1.047	1.127	.....	.....	.....	.....	.....
.135	10	.....	.....	.....	.....	.....	.....	.....	1.607	1.787	1.877	1.968	2.148
.150	9	.....	.....	.....	.....	.....	.....	.....	1.762	1.962	2.062	2.162	2.362
.156	5/32	.....		...	...	.	. .	.....	1.822	2.030	2.135	2.239	2.447

(These weights are calculated for the decimal thicknesses given in table.)

STANDARD SPECIFICATIONS FOR LOCOMOTIVE TUBES.—*Continued.*

Permissible Variations

12. The weight of the tubes shall not vary more than 5 per cent. from that specified in Table I.

V. WORKMANSHIP AND FINISH

Workmanship*

13. The finished tubes shall be circular within 0.02 inch, and the mean outside diameter shall not vary more than 0.015 inch from the size ordered. The thickness at any point shall not vary more than 10 per cent. from that specified. In the case of boiler tubes which are expanded and swaged, the thickness of the expanded end may be 1½ gauges lighter, and of the swaged end 2 gauges heavier than the thickness specified. The length shall not be less, but may be 0.125 inch more than that ordered.

Finish

14. The finished tubes shall be free from injurious defects and shall have a workmanlike finish. They shall be free from kinks, bends and buckles.

VI. MARKING

Marking

15. The name or brand of the manufacturer, and "Tested at 1000 pounds" for tubes under 5 inches in diameter, and "Tested at 800 pounds" for tubes 5 inches or over in diameter, shall be legibly stenciled in white on each tube.

VII. INSPECTION AND REJECTION

Inspection

16. The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the tubes ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the tubes are being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture, prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

*NOTE.—The customary practice of National Tube Company is to ship tubes larger than 4" O. D., in which the variation in diameter does not exceed ½ of 1 per cent. either way from standard. All gauging is done near the ends of the tubes.

STANDARD SPECIFICATIONS FOR LOCOMOTIVE TUBES.—*Continued.*

Rejection

17. (*a*) Unless otherwise specified, any rejection based on tests made in accordance with Section 3 shall be reported within five working days from the receipt of samples.

(*b*) Tubes when inserted in the boiler shall stand expanding and beading without showing cracks or flaws, or opening at the weld. Superheater pipes when properly manipulated shall stand all forging, welding and bending operations necessary for application without developing defects. Tubes or superheater pipes which fail in either of the above operations will be rejected and the manufacturer shall be notified.

Rehearing

18. Samples tested in accordance with Section 3, which represent rejected tubes, shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

"NATIONAL" SPELLERIZED LOCOMOTIVE BOILER TUBES

LAP-WELDED, OPEN-HEARTH STEEL

Thickness			Sizes
Decimal of an Inch	Approximate Equivalent in m/m	Nearest B. W. G. No.	
.095	2.41	13	Inches, outside diameter: 1¾″ 1⅞″ 2″ 2¼″ 2½″ 3″ (Equivalents in Millimeters: 44.45, 47.63, 50.80, 57.15, 63.50, 76.20)
.109 or .110	2.77 or 2.79	12	
.120 or .125	3.05 or 3.17	11	
.134 or .135	3.40 or 3.43	10	

We can furnish Locomotive Dry, Arch and Bridge Pipes, also Water Grates nd Tubes, of special thicknesses.

LOCOMOTIVE TUBES.—*Continued*

"SHELBY" SEAMLESS STEEL LOCOMOTIVE BOILER TUBES

COLD DRAWN—HOT ROLLED

Thickness			Sizes of Cold Drawn Tubes*
Decimal of an Inch	Approximate Equivalent in m/m	Nearest B. W. G. No.	
.095	2.41	13	Inches, outside diameter:
.109 or .110	2.77 or 2.79	12	1½", 1¾", 1⅞", 2", 2¼", 2½"
.120 or .125	3.05 or 3.17	11	(Equivalents in Millimeters:
.134 or .135	3.40 or 3.43	10	38.10, 44.45, 47.63, 50.80, 57.15, 63.50

*Hot Rolled Tubes, 2" furnished in No. 11 B. W. G. and heavier; 2¼" and larger f in No. 12 B. W. G. and heavier.

We can furnish "Shelby" Seamless Steel Dry, Arch, and Bridge Pipes Grates, Stay and Boiler Tubes, of special thicknesses.

"SHELBY" SEAMLESS STEEL SUPERHEATER TU

Thickness			Sizes
Dec. of an Inch	Approx. Equivalent in m/m	Nearest B.W.G. No. or Fraction of an Inch	
.135	3.43	No. 10	Inches, outside diameter:
.150	3.81	No. 9	1¼", 1⅜", 1 7/16", 1½", 1⅝", 5", 5¼", 5⅜",
.156	3.97	5/32"	(Equivalents in Millimeters:
.165	4.19	No. 8	31.75, 34.93, 36.51, 38.10, 41.28, 127, 133.35, 136.53
.187	4.75	3/16"	

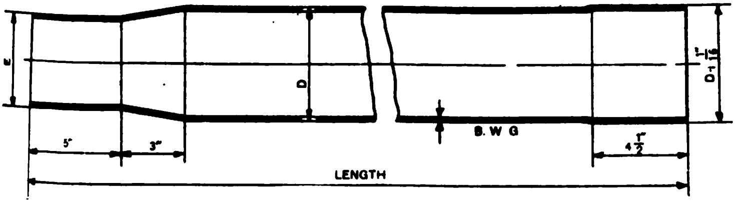
In lengths up to but not exceeding 24 feet (7.315 meters).

Locomotive Tubes.—*Continued*

SEAMLESS LOCOMOTIVE SUPERHEATER TUBES

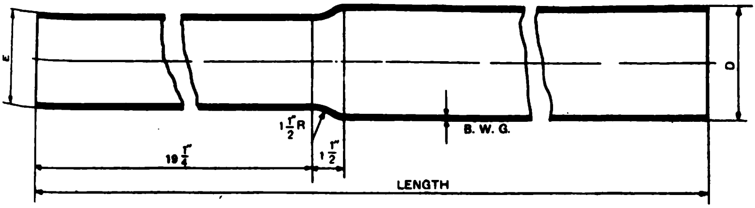
The following designs have been adopted by the railroads as standard, and are submitted for the purpose of eliminating the special cost incidental to tools of special designs, and also to facilitate deliveries in permitting us to carry a stock on hand.

STANDARD A SUPERHEATER



Part No.	D		E		B. W. G.	Length
	Inches	m/m	Inches	m/m		
1	5½	139.7	4½	114.3	As Ordered	As Ordered
2	5⅜	136.5	4½	114.3	" "	" "
3	5¼	133.4	4½	114.3	" "	" "
4	5	127.0	4⅛	104.8	" "	" "

STANDARD C SUPERHEATER

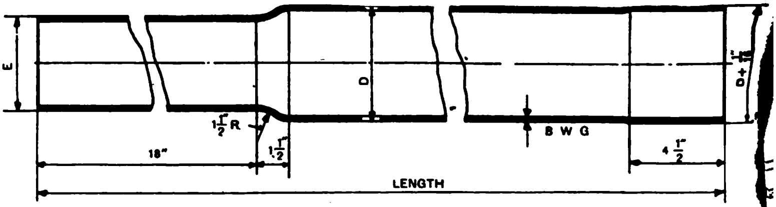


Part No.	D		E		B. W. G.	Length
	Inches	m/m	Inches	m/m		
1	5½	139.7	4½	114.3	As Ordered	As Ordered
2	5	127.0	4	101.6	" "	" "

LOCOMOTIVE TUBES.—*Continued*

SEAMLESS LOCOMOTIVE SUPERHEATER TUBES.—*Continued*

STANDARD D SUPERHEATER



Part No.	D		E		B. W. G.	Length
	Inches	m/m	Inches	m/m		
1	5½	139.7	4½	114.3	As Ordered	As Ordered
2	5⅜	136.5	4½	114.3	" "	" "

"NATIONAL" LAP-WELDED SUPERHEATER TUBES

Thickness			Sizes
Decimal of an Inch	Approximate Equivalent in m/m	Nearest B. W. G. No. or Fraction of an Inch	
.150	3.81	No. 9	Inches, outside diameter:
.156	3.97	5/32"	5", 5¼", 5⅜", 5½", 6"
.165	4.19	No. 8	(Equivalents in Millimeters:
.180	4.57	No. 7	127, 133.35, 136.53, 139.7, 152.4)
.187	4.75	3/16"	

In lengths up to but not exceeding 24 feet (7.315 meters).

STANDARD SPECIFICATIONS FOR ONE-INCH SIGNAL PIPE AND COUPLING

REPRINTED FROM SPECIFICATIONS OF
RAILWAY SIGNAL ASSOCIATION

REVISED TO JANUARY 10, 1916

NATIONAL TUBE COMPANY, SPECIFICATION NO. 1-B
SIGNAL PIPE

I. PIPE

1. Pipe must be of soft steel, straight, tough and uniform in quality; free n cinder pockets, blisters, burns and other injurious flaws. Must be hot anized inside and outside, unwiped.

2. The tensile strength, limit of elasticity and ductility shall be determined n a test piece cut from finished pipe.

3. The pipe shall have a tensile strength of not less than fifty-two thousand 000) pounds per square inch, and an elastic limit of not less than thirty isand (30,000) pounds per square inch, and an elongation of not less than teen (18) per cent. in a measured length of eight (8) inches. Pipe must d a test of six hundred (600) pounds per square inch internal hydrostatic sure without leak.

piece of pipe one (1) foot long will be selected at random and be subjected flattening test by hammering the piece until the opposite sides are within e the thickness of the wall from each other; the piece shall show no cracks he steel except at the weld.

4. The weight of one (1) foot of one (1) inch pipe before galvanizing should ne and seventy-one one-hundredths (1.71) pounds, and in no case will pipe accepted weighing less than one and sixty-three one-hundredths (1.63) nds per foot, weight of plug and coupling not included.

5. The outside diameter of pipe must conform to Briggs' standard. Any e enough less than one and thirty-one one-hundredths (1.31) inches in meter to result in flat thread will be rejected.

6. The manufacturer shall furnish all necessary facilities for making tests d the tests shall be made at the mill.

7. Inside diameter of all pipe must be large enough to receive a hardened el plug of sixty-three sixty-fourths ($\frac{63}{64}$) inch diameter for a length of six (6) ches.

STANDARD SPECIFICATIONS FOR ONE-INCH SIGNAL PIPE AND COUPLING.—*Continued*

8. Not more than one (1) per cent. of pipe less than fifteen (15) feet long will be accepted, lengths of seventeen (17) feet and over preferred.

9. Ends of pipe must be cut square and drilled for two (2) one-fourth (¼) inch rivets on one end only; first rivet hole shall be drilled two (2) inches from the end and the second two (2) inches from this and at right angles to it.

10. Each length of pipe shall have a thread one and one-eighth (1⅛) inches long, three-eighths (⅜) inch total taper per foot, eleven and one-half (11½) slightly rounded top and bottom "V" threads to the inch. The threaded portion of the pipe shall be of such diameter as to admit the coupling to be screwed on five (5) turns by hand, with a permissible variation of one (1) turn either way.

II. COUPLINGS

Couplings are to be galvanized, to be two and one-fourth (2¼) inches long and one and three-fourths (1¾) inches outside diameter, of wrought iron free from defects, faced at ends and tapped straight through, pitch diameter of thread to be one and twenty-six one-hundredths (1.26) inches, variation not more than three-thousandths (.003) of an inch, so as to fit pipe as per section ten (10) above.

III. PLUGS

Plugs must be merchant bar steel, ten (10) inches long, thirty-one thirty-seconds ($\frac{31}{32}$) inch in diameter, drilled for four (4) one-fourth (¼) inch rivets with drill two hundred and fifty-six one-thousandths (.256); spacing to be one (1) inch, two (2) inches, four (4) inches, two (2) inches, one (1) inch, the outside holes to be in one plane and the inside holes to be in a plane at right angles to the outside holes.

IV. RIVETS

Rivets must be galvanized, must be of soft iron or steel one-fourth (¼) inch in diameter, one and eleven-sixteenths ($1\frac{11}{16}$) inches long.

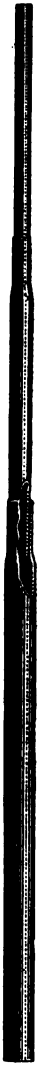
"NATIONAL" WROUGHT STEEL TUBULAR POLES

Standard Poles made from Standard Weight Pipe, or from Extra Heavy Pipe, or with bottom section Extra Heavy, and other sections Standard Weight pipe, or with bottom and middle sections Extra Heavy, and top section Standard Weight Pipe.

Poles of any length, weight, or combination of sizes, made to order. Designs furnished to meet any given requirements for Electric Railways, Electric Lighting, Telegraph, Telephone, and Power Transmission Service. The section lengths being known, the approximate weight of any pole can be calculated by using the tables of approximate weights of Standard, Extra Strong, or Double Extra Strong Pipe on pages 200, 203 and 204 of this Catalogue.

Sizes heavier or lighter can be made by changing the thickness and internal diameter, also by furnishing special outside diameter sizes of pipe.

Expense and time will usually be saved by using poles selected from the following tables, where a sufficient variety of lengths and sizes is given to meet nearly all requirements of practice.



Three-Section
Pole

ection
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"NATIONAL" WROUGHT STEEL TUBULAR POI POLE BRACKETS, AND OTHER ACCESSORIES FOR

ELECTRIC TRAMWAYS, ELECTRIC LIGHTING, TELEGRAPH, TELEPHONE POWER TRANSMISSION SERVICE

The wide use of "National" tubular poles is an evidence of the ı
progressive spirit. For neatness and uniformity of appearance, for orna
tion, and for great durability, stiffness and strength, "National" tubul
are giving most satisfactory returns to cities, electric light, telephone, tr
and power companies for the capital invested.

Customary Sizes.—For railway work the poles most used are 30 fe
and are composed of 7-inch, 6-inch, and 5-inch pipes. These are u
both center-pole and span-wire construction. Anchor poles are usu
8-inch, 7-inch, and 6-inch pipes, although they are frequently made o
sizes, often being of 10-inch, 9-inch and 8-inch pipes. Poles 28 and
long are used to a large extent. Such lengths as 29, 31 and 32 feet
common. The British Standard tramway pole is 31 feet long; their st
permits no other length. The length of poles should never be speci
fractional inches, because the practical operation of assembling int
variations of ¼ inch or ½ inch not infrequently.

The length of poles appears to depend mostly upon the clearance r
below the wires, in order to avoid injury to the wires or injury from
contact with those carrying high-tension lines. The length is also a
to the extent of several feet, by the nature of ground in which planted a
depth of the frost line. The depth of planting above the frost line app
give little aid in holding the pole, if indeed such depth does not tend
turb the foundation of that portion below the frost line.

These considerations make it impossible to give any general stat
as to the lengths of poles for telephone, telegraph, or transmission lin
some instances entire lines are carried at great height, as if the effort

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

avoid chance contact. Such height may be required when the lines are on public highways or at road crossings. There has appeared, during recent years, a tendency to place the lines at lower elevation and only to raise them where the line crosses roads or public property. This seems especially true of the high-voltage lines, where there appears a strong tendency to have a private right-of-way strip, even fenced in, and the wires carried low, except at crossings. The claim has been made that it is cheaper to use very high poles, long spans and great sags, but actual installations appear to tend towards the opposite construction.

Pages 448 to 485 give table of standard poles. Sufficient variety of lengths, sizes, diameters and sections is given to meet nearly all requirements of practice.

Section Lengths.—Lengths of sections given in the tables have been selected so as to employ the regular mill-furnace lengths, without producing unnecessary scrap, and at the same time produce poles of light weight in relation to their strength and stiffness. The section lengths given conform closely to those that are usually employed. These lengths should be specified, except when the practical requirements justify the increased cost.

Odd Sizes.—Odd sizes, thickness and weights mean special production, delay, and increased cost, therefore they should always be avoided, because such pipe has always to be made to order. Where it is not practical to use poles made up of standard or extra-strong pipe, it is advisable to use only the sizes and weights given in one of the standard lists of tubular goods.

Material Used.—The material of which these poles are made is usually known as "Soft Mild Steel." Its ultimate strength will average not less than 50,000 pounds per square inch, and its elastic limit—or yield point—not less than 30,000 pounds per square inch.

Deflection.—The deflection is roughly proportional to the stress produced. In these tables the deflection test loads are limited to those which produce stress of about 18,000 pounds per square inch. Deflections depend on the elastic property of the material; however, in tabulating this it is not used

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

directly but has been adjusted to compensate for manufacturing irregularities so as to yield limits that tests will not exceed. The maximum and average deflections will thus always be less than the tabulated figures.

Many specifications have been drawn up requiring poles of widely different lengths and diameters, all to stand the same deflection; this figure is commonly 6 inches. By reference to the tables it will be seen that a pole 22 feet long of 13-inch and 12-inch pipe should not be deflected more than about 1-inch, and that a pole 39 feet long of 4-inch, 3-inch and 2½-inch pipe should be deflected about 18 inches when testing for deflection. It is thus evident that a constant figure like 6 inches for deflection may be six times more than, or only one-third of the amount that it ought to be. By reference to the tables it will be seen that a deflection of 6 inches is about the suitable figure for a pole 31 feet long of 6-inch, 5-inch and 4-inch pipe. It is noteworthy that this length pole is the British Standard. Some framers of specifications have attempted to overcome the difficulty by reducing the limit deflection to 3 inches and some to 1½ inches. Against such it is proper to urge that 1½ inches would not strain a pole 39 feet long of 4-inch, 3-inch and 2½-inch pipe sufficiently for the test to give any indication of the quality of the pole. It is more rational to use such load as will produce about a constant stress in the material and then fix the deflection limit to correspond. This has been done in the standard tables.

Set Limits.—Poles are suitable for a certain maximum load that may be applied without producing an appreciable permanent distortion, remaining after the load is removed. Such loads should not produce a fiber stress above the yield point. As 30,000 pounds is approximately the yield point of this material, 27,000 pounds per square inch has been used in determining the "Maximum Load *P*" given in the tables. After applying and removing such a load, there usually remains a small fraction as permanent deflection (or set, as it is generally called). Some specifications have limited this to a constant figure, such as 1 inch or ½ inch, but this constant figure is as inappropriate for set as a constant figure is inappropriate for deflection. Tests have shown that *the set on first loading* seldom exceeds 10 per cent. of the distortion produced by

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

e "Maximum Load" tabulated. Thus a pole, which is deflected 5 inches test, should not show a permanent set exceeding ½ inch, but a pole that is flected 15 inches on test may show a set of 1.5 inches without exceeding tional bounds.

Deflection Versus Weight.—By comparing the deflections tabulated, it will e seen that a pole of large diameter and thinner pipe is slightly stiffer and ghter than one of less diameter and greater thickness. Compare poles Nos. 7622 and 7651. The strength is say 9 per cent. less, while the stiffness is ncreased a per cent. or so, but there is a saving in weight of about 23 per cent. n general both strength and stiffness increase more rapidly than the weight as the diameter increases. On the other hand, for one diameter the weight increases more rapidly than the strength or stiffness, as the thickness is changed. This points to the advisability of always using as large a diameter as possible.

Dog Guards, or Protecting Sleeves.—(See page 486 for illustration.) The deterioration of poles, of all materials, occurs most rapidly at or near the surface of the ground. In order to prolong the life of poles it is necessary to protect this portion. Steel poles lend themselves most readily to such protection because a "dog guard," made of a piece of larger and thicker pipe, may be slid over the pole from the butt end, and then swaged and shrunk on so that say one-third of its length will be below and two-thirds above the ground line. These dog guards are applied at a red heat, and effectually prevent water entering between the pole and dog guard. They are usually made 2 feet long and ½ inch thick. They thus would at least double the life of a pole of extra-heavy pipe, and frequently treble the life of a pole of standard pipe.

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

The usual practice in "dog guards" is to make them 2 feet long and sufficient inside diameter to slide easily over the butt section, as here tabulated

Butt of Pole				Sleeve Before Swaging							
Nominal Size		Outside Diameter		Outside Diameter		Thickness		Weight		Weight per Sleeve 2 Feet Long	
Inches	m/m	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos	Pounds	Kilos
3	76.2	3.50	88.9	4.50	114.3	.337	8.56	14.98	22.29	29.97	13.6
4	101.6	4.50	114.3	5.56	141.3	.375	9.52	20.78	30.92	41.56	18.9
5	127.0	5.56	141.3	6.62	168.3	.432	10.97	28.57	42.52	57.15	25.9
6	152.4	6.62	168.3	8.00	203.2	.500	12.70	40.05	59.60	80.10	36.3
7	177.8	7.62	193.7	9.00	228.6	.500	12.70	45.39	67.54	90.78	41.2
8	203.2	8.62	219.1	10.00	254.0	.500	12.70	50.73	75.49	101.46	46.0
9	228.6	9.62	244.5	11.00	279.4	.500	12.70	56.07	83.44	112.14	50.9
10	254.0	10.75	273.0	12.00	304.8	.500	12.70	61.41	91.38	122.82	55.7
11	279.4	11.75	298.4	13.00	330.2	.500	12.70	66.75	99.33	133.50	60.6
12	304.8	12.75	323.8	14.00	355.6	.500	12.70	72.09	107.29	144.18	65.4
13	330.2	14.00	355.6	16.00	406.4	.500	12.70	82.77	123.18	165.54	75.1

Test Conditions.—The test condition (butt fixed for 6 feet and load applied 18 inches below the top) used on these tables is that which the great majority of specifications impose. It has remained the same for many years, so that it may, in a general way, be considered the "Standard" condition for pole tests.

Joints.—The joints between the sections of poles are made by inserting the smaller pipe 18 inches into the larger pipe while the latter is at a red heat, swaging down the heated portion and then allowing the joint to cool and shrink. The length inserted is almost invariably 18 inches, but other lengths can be worked when called for.

Painting.—Poles are always painted before leaving the maker's works. Unless customers specify the color, poles are painted red.

Standard Poles.—*Tables.* The National Tube Company's table of Standard poles is given on the following pages. It is recommended not to depart from the section lengths given in the table. These tables of poles give all essential details for maker and user.

Pole num **identification.**

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Column headed "Size of butt" gives the nominal size of pipe used in the butt section. ***The upper sections are each one inch, pipe size, smaller than the ection next below, except that 2½ inch is used in 3-inch.***

Column headed "Thickness" gives the nominal thickness of each section om the bottom up, by the use of symbols f and E, which mean standard and tra strong, respectively; *e. g.*, *Eff* means extra-strong pipe in bottom sec-on and standard pipe the two upper sections.

Column headed "Maximum load (P)" gives the load that pole will carry, pplied 18 inches below the top when pole is planted or "fixed" for a distance 6 feet. It is figured at 27,000 pounds per square inch fiber stress in the aterial.

Column headed "Load (L)" for deflection "D" gives the load that it is itable to specify when poles must be tested for deflection. This deflection st load is about two-thirds of the maximum load P.

Column headed "Deflection for Load L" gives the maximum deflection in iches at point of load when pole is fixed as a cantilever for a distance of feet and load L is applied 18 inches below top. D—deflection limit.

Column headed "Factor R" gives the rate of deflection in inches per 100 ounds load.

Column headed "Factor m" gives a factor for computing the approximate eflection "D'" at any point situated "n" inches above the point of application the load, by means of formula "D'" $= D\ (m + n)/m$, all other conditions maining as before.

By reason of the slight, unavoidable variations in manufacture, the data iown in the following tubular electric line pole tables are not absolutely rrect, but the element of error is very small.

Any pole given in these tables will conform to the following specifications:

Specifications.—All poles shall be composed of wrought-steel pipes. Joints all be made by inserting the smaller pipe cold into the larger pipe a distance 18 inches, and while the latter is hot, swaging it upon the smaller and owing them to cool and shrink. No shims, wires, liners, pins, rivets, punch rks, or any device that weakens material at joint will be allowed.

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Any pole when fixed for a distance of six feet from the butt end and t
as a cantilever with the load given in column *P*, applied 18 inches below
top, shall not show a set or permanent deflection in excess of 10 per cen
the temporary deflection under this load, but this set limit may not be pl
at less than ½-inch in any case. Any pole tested as before, but with the
in pounds given in column *L*, shall not show a temporary deflection in inc
at the point of load, exceeding the figure given in column *D*.

Any pole when dropped three times, butt foremost, from a height of
feet upon a solid wood block on a rigid base shall not telescope at the joint

Weight of completed pole shall not vary more than 5 per cent. abov
5 per cent. below the weight given in column headed "Weight."

The list below gives pipes used for poles in the following tables.

Standard Pipe (Denoted by symbol "*f*")						Extra-strong Pipe (Denoted by symbol "					
Nominal Size		Thickness		Weight		Nominal Size		Thickness		Weight	
Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inch	m/m	Per Foot, Pounds	P Me Ki
2½	64	.203	5.16	5.79	8.62	2½	64	.276	7.01	7.66	11.
3	76	.216	5.49	7.58	11.28	3	76	.300	7.62	10.25	15.
4	102	.237	6.02	10.79	16.06	4	102	.337	8.56	14.98	22.
5	127	.258	6.55	14.62	21.76	5	127	.375	9.52	20.78	30
6	152	.280	7.11	18.97	28.23	6	152	.432	10.97	28.57	42.
7	178	.301	7.65	23.54	35.03	7	178	.500	12.70	38.05	56.
8	203	.322	8.18	28.55	42.49	8	203	.500	12.70	43.39	64
9	229	.342	8.69	33.91	50.46	9	229	.500	12.70	48.73	72
10	254	.365	9.27	40.48	60.24	10	254	.500	12.70	54.74	81
11	279	.375	9.52	45.56	67.80	11	279	.500	12.70	60.08	89.
12	305	.375	9.52	49.56	73.75	12	305	.500	12.70	65.42	97
13	330	.375	9.52	54.57	81.20	13	330	.500	12.70	72.09	107

NOTE.—The above is the same pipe shown on pages 200 and 203. Wei
here given are without couplings.

"National" Wrought Steel Tubular Poles.—*Continued*

Length of Pole—22 Feet (6.706 meters)

ections: 18 feet 6 inches and 5 feet (5.638 meters and 1.524 meters)

Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
3	76	169	77	*ff*	267	121	180	82	4.19	106.4	2.33	114
4	102	238	108	"	499	226	350	159	3.41	86.6	.975	113
5	127	324	147	"	846	384	550	249	2.55	64.8	.465	114
6	152	425	193	"	1318	598	900	408	2.25	57.1	.250	114
7	178	530	240	"	1893	859	1300	590	1.96	49.8	.151	115
8	203	647	294	"	2609	1183	1700	771	1.65	41.9	.0970	115
9	229	770	349	"	3469	1573	2300	1043	1.50	38.1	.0654	115
10	254	919	417	"	4641	2105	3100	1406	1.36	34.5	.0438	116
11	279	1046	475	"	5732	2600	3800	1723	1.23	31.2	.0324	116
12	305	1146	520	"	6801	3085	4500	2041	1.13	28.7	.0252	116
13	330	1258	571	"	8265	3749	5500	2495	1.03	26.2	.0188	115
3	76	220	100	*Ef*	347	157	220	100	3.96	100.6	1.80	113
4	102	315	143	"	663	301	450	204	3.30	83.8	.735	112
5	127	433	196	"	1141	518	750	340	2.58	65.5	.345	113
6	152	602	273	"	1897	860	1300	590	2.26	57.4	.174	113
7	178	798	362	"	2905	1318	1900	862	1.88	47.8	.0988	113
8	203	920	417	"	3805	1726	2500	1134	1.67	42.4	.0666	114
9	229	1044	474	"	4826	2189	3200	1451	1.50	38.1	.0471	114
10	254	1182	536	"	6120	2776	4000	1814	1.33	33.8	.0333	114
11	279	1314	596	"	7401	3357	5000	2268	1.26	32.0	.0251	114
12	305	1438	652	"	8802	3992	5800	2631	1.12	28.4	.0194	114
13	330	1582	718	"	10727	4865	7200	3266	1.05	26.7	.0146	115
3	76	229	104	*EE*	347	157	220	100	3.96	100.6	1.80	114
4	102	329	149	"	663	301	450	204	3.30	83.8	.734	113
5	127	454	206	"	1141	518	750	340	2.58	65.5	.344	114
6	152	632	287	"	1897	860	1300	590	2.26	57.4	.174	114
7	178	846	384	"	2905	1318	1900	862	1.87	47.5	.0986	115
8	203	993	450	"	3805	1726	2500	1134	1.66	42.2	.0665	115
9	229	1118	507	"	4826	2189	3200	1451	1.50	38.1	.0470	116
10	254	1250	567	"	6120	2776	4000	1814	1.33	33.8	.0332	115
11	279	1385	628	"	7401	3357	5000	2268	1.26	32.0	.0251	115
12	305	1510	685	"	8802	3992	5800	2631	1.12	28.4	.0194	115
13	330	1661	753	"	10727	4865	7200	3266	1.05	26.7	.0146	116

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—23 Feet (7.011 meters)

Sections: 19 feet 6 inches and 5 feet (5.943 meters and 1.524 meter

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D*		Deflection for Load *L*		Factor *R*
								L		*D*		
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m	
7033	3	76	177	80	*ff*	250	113	170	77	4.85	123.2	2.85
7034	4	102	249	113	"	466	211	300	136	3.57	90.7	1.19
7035	5	127	339	154	"	791	359	550	249	3.12	79.2	.567
7036	6	152	444	201	"	1233	559	800	363	2.44	62.0	.305
7037	7	178	553	251	"	1771	803	1200	544	2.22	56.4	.185
7038	8	203	675	306	"	2440	1107	1600	726	1.90	48.3	.119
7039	9	229	804	365	"	3245	1472	2200	998	1.76	44.7	.0798
7040	10	254	959	435	"	4342	1969	2900	1315	1.55	39.4	.0535
7041	11	279	1092	495	"	5362	2432	3600	1633	1.42	36.1	.0395
7042	12	305	1195	542	"	6362	2886	4200	1905	1.29	32.8	.0307
7043	13	330	1313	596	"	7732	3507	5200	2359	1.20	30.5	.0230
7044	3	76	230	104	*Ef*	324	147	220	100	4.84	122.9	2.20
7045	4	102	330	150	"	620	281	400	181	3.59	91.2	.897
7046	5	127	454	206	"	1068	484	700	318	2.95	74.9	.421
7047	6	152	631	286	"	1774	805	1200	544	2.56	65.0	.213
7048	7	178	836	379	"	2718	1233	1800	816	2.18	55.4	.121
7049	8	203	964	437	"	3559	1614	2400	1089	1.95	49.5	.0813
7050	9	229	1093	496	"	4515	2048	3000	1361	1.73	43.9	.0575
7051	10	254	1236	561	"	5725	2597	3800	1724	1.54	39.1	.0406
7052	11	279	1375	624	"	6923	3140	4500	2041	1.38	35.1	.0306
7053	12	305	1503	682	"	8234	3735	5500	2495	1.31	33.3	.0238
7054	13	330	1654	750	"	10034	4552	6800	3084	1.21	30.7	.0178
7055	3	76	239	108	*EE*	324	147	220	100	4.84	122.9	2.20
7056	4	102	344	156	"	620	281	400	181	3.58	90.9	.896
7057	5	127	475	215	"	1067	484	700	318	2.95	74.9	.421
7058	6	152	660	299	"	1774	805	1200	544	2.54	64.5	.212
7059	7	178	884	401	"	2718	1233	1800	816	2.16	54.9	.120
7060	8	203	1036	470	"	3559	1614	2400	1089	1.95	49.5	.0812
7061	9	229	1167	529	"	4514	2048	3000	1361	1.73	43.9	.0575
7062	10	254	1310	594	"	5725	2597	3800	1724	1.54	39.1	.0405
7063	11	279	1446	656	"	6923	3140	4500	2041	1.38	35.1	.0306
7064	12	305	1576	715	"	8234	3735	5500	2495	1.31	33.3	.0238
7065	13	330	1733	786	"	10034	4552	6800	3084	1.21	30.7	.0178

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—24 Feet (7.315 meters)

ections: 18 feet 6 inches and 7 feet (5.638 meters and 2.134 meters)

Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D*		Deflection for Load *L*		Factor *R*	Factor *m*
							L		*D*			
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
3	76	181	82	*ff*	235	107	160	73	5.57	141.5	3.48	127
4	102	253	115	"	438	199	300	136	4.38	111.2	1.46	124
5	127	346	157	"	743	337	500	227	3.47	88.1	.694	126
6	152	454	206	"	1158	525	750	340	2.79	70.9	.372	127
7	178	568	258	"	1664	755	1100	499	2.48	63.0	.225	128
8	203	694	315	"	2292	1040	1500	680	2.16	54.9	.144	129
9	229	827	375	"	3049	1383	2000	907	1.94	49.3	.0968	129
10	254	987	448	"	4079	1850	2700	1225	1.75	44.5	.0648	129
11	279	1127	511	"	5037	2285	3400	1542	1.63	41.4	.0480	131
12	305	1237	561	"	5977	2711	4000	1814	1.49	37.8	.0372	130
13	330	1357	616	"	7263	3294	4800	2177	1.34	34.0	.0280	131
3	76	231	105	*Ef*	305	138	200	91	5.40	137.2	2.70	124
4	102	331	150	"	582	264	400	181	4.44	112.8	1.11	121
5	127	455	206	"	1002	455	650	295	3.37	85.6	.519	122
6	152	631	286	"	1667	756	1100	499	2.88	73.2	.262	123
7	178	836	379	"	2553	1158	1700	771	2.52	64.0	.148	124
8	203	967	439	"	3343	1516	2200	998	2.19	55.6	.0996	125
9	229	1101	499	"	4241	1924	2800	1270	1.97	50.0	.0702	126
10	254	1249	567	"	5378	2439	3600	1633	1.78	45.2	.0495	127
11	279	1395	633	"	6503	2950	4200	1905	1.57	39.9	.0374	128
12	305	1529	694	"	7735	3508	5200	2359	1.50	38.1	.0289	128
13	330	1681	762	"	9426	4276	6200	2812	1.34	34.0	.0216	128
3	76	244	111	*EE*	305	138	200	91	5.36	136.1	2.68	126
4	102	350	159	"	582	264	400	181	4.40	11.8	1.10	124
5	127	484	220	"	1002	455	650	295	3.34	84.8	.514	126
6	152	673	305	"	1667	756	1100	499	2.85	72.4	.259	127
7	178	903	410	"	2553	1158	1700	771	2.50	63.5	.147	128
8	203	1069	485	"	3343	1516	2200	998	2.17	55.1	.0986	129
9	229	1205	547	"	4241	1924	2800	1270	1.95	49.5	.0696	130
10	254	1353	614	"	5378	2439	3600	1633	1.77	45.0	.0491	130
11	279	1495	678	"	6503	2950	4200	1905	1.56	39.6	.0371	130
12	305	1631	740	"	7735	3508	5200	2359	1.50	38.1	.0288	131
13	330	1792	813	"	9426	4276	6200	2812	1.33	33.8	0214	129

"National" Wrought Steel Tubular Poles.—*Continued*

Length of Pole—24 Feet (7.315 meters)

Sections: 19 feet, 4 feet and 4 feet (5.791 meters, 1.219 meters and 1.219 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load P		Load for Deflection D L		Deflection for Load L D		Factor R	Factor m
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
7099	4	102	259	117	*fff*	438	199	300	136	4.35	110.5	1.45	125
7100	5	127	351	159	"	743	337	500	227	3.45	87.6	.690	126
7101	6	152	463	210	"	1159	526	750	340	2.78	70.6	.371	127
7102	7	178	581	264	"	1664	755	1100	499	2.46	62.5	.224	129
7103	8	203	713	323	"	2292	1040	1500	680	2.16	54.9	.144	129
7104	9	229	853	387	"	3049	1383	2000	907	1.93	49.0	.0966	129
7105	10	254	1020	463	"	4079	1850	2700	1225	1.75	44.4	.0647	129
7106	11	279	1164	528	"	5037	2285	3400	1542	1.63	41.4	.0478	130
7107	12	305	1287	584	"	5977	2711	4000	1814	1.49	37.8	.0372	130
7108	13	330	1418	643	"	7264	3295	4800	2177	1.34	34.0	.0279	131
7109	4	102	339	154	*Eff*	582	264	400	181	4.40	111.8	1.10	122
7110	5	127	463	210	"	1002	455	650	295	3.35	85.1	.515	123
7111	6	152	645	293	"	1667	756	1100	499	2.86	72.6	.260	124
7112	7	178	856	388	"	2553	1158	1700	771	2.50	63.5	.147	124
7113	8	203	995	451	"	3343	1516	2200	998	2.18	55.4	.0992	126
7114	9	229	1134	514	"	4241	1924	2800	1270	1.96	49.8	.0699	127
7115	10	254	1289	585	"	5378	2439	3600	1633	1.77	45.0	.0492	127
7116	11	279	1440	653	"	6503	2950	4200	1905	1.56	39.6	.0372	128
7117	12	305	1587	720	"	7735	3508	5200	2359	1.50	38.1	.0288	129
7118	13	330	1751	794	"	9426	4276	6200	2812	1.34	34.0	.0216	130
7119	4	102	349	158	*EEf*	582	264	400	181	4.36	110.7	1.09	124
7120	5	127	480	218	"	1002	455	650	295	3.33	84.6	.512	125
7121	6	152	669	303	"	1667	756	1100	499	2.84	72.1	.258	126
7122	7	178	895	406	"	2553	1158	1700	771	2.48	63.0	.146	127
7123	8	203	1053	478	"	3343	1516	2200	998	2.16	54.9	.0984	129
7124	9	229	1193	541	"	4241	1924	2800	1270	1.95	49.5	.0695	130
7125	10	254	1349	612	"	5378	2439	3600	1633	1.76	44.7	.0490	130
7126	11	279	1496	679	"	6503	2950	4200	1905	1.56	39.6	.0371	131
7127	12	305	1645	746	"	7735	3508	5200	2359	1.49	37.8	.0287	131
7128	13	330	1814	823	"	9426	4276	6200	2812	1.33	33.8	.0215	131
7129	4	102	357	162	*EEE*	582	264	400	181	4.36	110.7	1.09	125
7130	5	127	491	223	"	1002	455	650	295	3.33	84.6	.512	126
7131	6	152	685	311	"	1667	756	1100	499	2.84	72.1	.258	127
7132	7	178	918	416	"	2553	1158	1700	771	2.48	63.0	.146	128
7133	8	203	1091	495	"	3343	1516	2200	998	2.16	54.9	.0984	129
7134	9	229	1251	567	"	4241	1924	2800	1270	1.95	49.5	.0695	130
7135	10	254	1408	639	"	5378	2439	3600	1633	1.76	44.7	.0490	130
7136	11	279	1556	706	"	6503	2950	4200	1905	1.56	39.6	.0371	131
7137	12	305	1702	772	"	7735	3508	5200	2359	1.49	37.8	.0287	132
7138	13	330	1872	849	"	9426	4276	6200	2812	1.33	33.8	.0215	131

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—25 Feet (7.620 meters)

ections: 19 feet 6 inches and 7 feet (5.943 meters and 2.134 meters)

Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
3	76	188	85	*ff*	221	100	150	68	6.21	157.7	4.14	135
4	102	264	120	"	413	187	280	127	4.87	123.7	1.74	133
5	127	360	163	"	701	318	450	204	3.71	94.2	.825	134
6	152	473	215	"	1092	495	750	340	3.32	84.3	.443	135
7	178	591	268	"	1569	712	1000	454	2.68	68.1	.268	136
8	203	722	327	"	2161	980	1400	635	2.39	60.7	.171	137
9	229	861	391	"	2875	1304	1900	862	2.19	55.6	.115	137
10	254	1027	466	"	3845	1744	2600	1179	2.01	51.1	.0773	137
11	279	1173	532	"	4749	2154	3200	1451	1.83	46.5	.0572	138
12	305	1286	583	"	5635	2556	3900	1769	1.73	43.9	.0444	138
13	330	1412	640	"	6848	3106	4800	2177	1.60	40.6	.0333	138
3	76	241	109	*Ef*	287	130	190	86	6.10	154.9	3.21	132
4	102	346	157	"	549	249	350	159	4.62	117.3	1.32	129
5	127	475	215	"	945	429	650	295	4.01	101.9	.617	131
6	152	660	299	"	1572	713	1000	454	3.11	79.0	.311	131
7	178	874	396	"	2407	1092	1600	726	2.82	71.6	.176	132
8	203	1011	459	"	3152	1430	2100	953	2.50	63.5	.119	133
9	229	1150	522	"	3998	1813	2700	1225	2.25	57.1	.0835	134
10	254	1304	591	"	5071	2300	3400	1542	2.00	50.8	.0589	134
11	279	1456	660	"	6132	2781	4000	1814	1.78	45.2	.0445	136
12	305	1595	723	"	7293	3308	4800	2177	1.65	41.9	.0344	136
13	330	1753	795	"	8888	4032	6000	2721	1.55	39.4	.0258	137
3	76	255	116	*EE*	287	130	190	86	6.06	153.9	3.19	135
4	102	365	166	"	549	249	350	159	4.59	116.6	1.31	132
5	127	505	229	"	945	429	650	295	3.98	101.1	.612	134
6	152	701	318	"	1572	713	1000	454	3.09	78.5	.309	135
7	178	941	427	"	2407	1092	1600	726	2.80	71.1	.175	136
8	203	1112	504	"	3152	1430	2100	953	2.48	63.0	.118	137
9	229	1254	569	"	3998	1813	2700	1225	2.24	56.9	.0830	138
10	254	1408	639	"	5071	2300	3400	1542	1.99	50.5	.0585	137
11	279	1555	705	"	6132	2781	4000	1841	1.77	45.0	.0442	138
12	305	1696	769	"	7293	3308	4800	2177	1.65	41.9	.0343	139
13	330	1864	845	"	8888	4032	6000	2721	1.54	39.1	.0256	138

"National" Wrought Steel Tubular Poles.—*Continued*

Length of Pole—25 Feet (7.620 meters)

Sections: 19 feet, 5 feet and 4 feet (5.791 meters, 1.524 meters and 1.2 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load P		Load for Deflection D L		Deflection for Load L D		Factor R	Fa
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
7172	4	102	266	121	*fff*	413	187	280	127	4.90	124.5	1.75	
7173	5	127	362	164	"	701	318	450	204	3.74	95.0	.830	
7174	6	152	477	216	"	1092	495	750	340	3.34	84.8	.445	
7175	7	178	600	272	"	1569	712	1000	454	2.69	68.3	.269	
7176	8	203	737	334	"	2161	980	1400	635	2.41	61.2	.172	
7177	9	229	881	400	"	2875	1304	1900	862	2.20	55.9	.116	
7178	10	254	1053	478	"	3845	1744	2600	1179	2.02	51.3	.0775	
7179	11	279	1205	547	"	4749	2154	3200	1451	1.83	46.5	.0573	
7180	12	305	1332	604	"	5635	2556	3900	1769	1.73	43.9	.0444	
7181	13	330	1468	666	"	6848	3106	4800	2177	1.60	40.6	.0333	
7182	4	102	346	157	*Eff*	549	249	350	159	4.66	118.4	1.33	
7183	5	127	474	215	"	945	429	650	295	4.05	102.9	.623	
7184	6	152	660	299	"	1572	713	1000	454	3.14	79.8	.314	
7185	7	178	875	397	"	2407	1092	1600	726	2.85	72.4	.178	
7186	8	203	1018	462	"	3152	1430	2100	953	2.50	63.5	.119	
7187	9	229	1162	527	"	3998	1813	2700	1225	2.27	57.7	.0840	
7188	10	254	1323	600	"	5071	2300	3400	1542	2.01	51.1	.0592	
7189	11	279	1480	671	"	6132	2781	4000	1814	1.79	45.5	.0447	
7190	12	305	1633	741	"	7293	3308	4800	2177	1.66	42.2	.0345	
7191	13	330	1800	816	"	8888	4032	6000	2721	1.55	39.4	.0259	
7192	4	102	360	163	*EEf*	549	249	350	159	4.62	117.3	1.32	
7193	5	127	495	225	"	945	429	650	295	4.00	101.6	.616	
7194	6	152	689	313	"	1572	713	1000	454	3.10	78.7	.310	
7195	7	178	923	419	"	2407	1092	1600	726	2.80	71.1	.175	
7196	8	203	1091	495	"	3152	1430	2100	953	2.48	63.0	.118	
7197	9	229	1236	561	"	3998	1813	2700	1225	2.25	57.1	.0832	
7198	10	254	1397	634	"	5071	2300	3400	1542	2.00	50.8	.0587	
7199	11	279	1551	703	"	6132	2781	4000	1814	1.77	45.0	.0443	
7200	12	305	1705	773	"	7293	3308	4800	2177	1.65	41.9	.0343	
7201	13	330	1879	852	"	8888	4032	6000	2721	1.54	39.1	.0257	
7202	4	102	367	166	*EEE*	549	249	350	159	4.62	117.3	1.32	
7203	5	127	506	230	"	945	429	650	295	4.00	101.6	.616	
7204	6	152	706	320	"	1572	713	1000	454	3.10	78.7	.310	
7205	7	178	947	430	"	2407	1092	1600	726	2.80	71.1	.175	
7206	8	203	1129	512	"	3152	1430	2100	953	2.48	63.0	.118	
7207	9	229	1294	587	"	3998	1813	2700	1225	2.25	57.1	.0832	
7208	10	254	1456	660	"	5071	2300	3400	1542	2.00	50.8	.0587	
7209	11	279	1610	730	"	6132	2781	4000	1814	1.77	45.0	.0443	
7210	12	305	1762	799	"	7293	3308	4800	2177	1.65	41.9	.0343	
7211	13	330	1937	879	"	8888	4032	6000	2721	1.54	39.1	.0257	

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—26 Feet (7.925 meters)

Sections: 20 feet 6 inches and 7 feet (6.248 meters and 2.134 meters)

Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
3	76	196	89	*ff*	209	95	140	64	6.83	173.5	4.88	143
4	102	275	125	"	391	177	250	113	5.13	130.3	2.05	141
5	127	375	170	"	663	301	450	204	4.38	111.2	.973	142
6	152	492	223	"	1033	469	700	318	3.66	93.0	.523	144
7	178	615	279	"	1484	673	1000	454	3.16	80.3	.316	145
8	203	751	341	"	2044	927	1400	635	2.83	71.9	.202	145
9	229	895	406	"	2719	1233	1800	816	2.45	62.2	.136	145
10	254	1068	484	"	3638	1650	2400	1089	2.19	55.6	.0912	145
11	279	1218	552	"	4493	2038	3000	1361	2.03	51.6	.0675	147
12	305	1336	606	"	5330	2418	3600	1633	1.88	47.8	.0523	146
13	330	1467	665	"	6478	2938	4200	1905	1.65	41.9	.0393	147
3	76	252	114	*Ef*	272	123	180	82	6.82	173.2	3.79	140
4	102	361	164	"	519	235	350	159	5.43	137.9	1.55	137
5	127	496	225	"	894	406	600	272	4.36	110.7	.726	139
6	152	689	313	"	1487	674	1000	454	3.66	93.0	.366	140
7	178	912	414	"	2277	1033	1500	680	3.12	79.2	.208	140
8	203	1054	478	"	2982	1353	2000	907	2.80	71.1	.140	141
9	229	1199	544	"	3782	1716	2500	1134	2.46	62.5	.0985	142
10	254	1359	616	"	4797	2176	3200	1451	2.22	56.4	.0695	143
11	279	1516	688	"	5800	2631	3900	1769	2.05	52.1	.0525	145
12	305	1660	753	"	6899	3129	4500	2041	1.83	46.5	.0406	144
13	330	1825	828	"	8407	3813	5500	2495	1.67	42.4	.0304	145
3	76	265	120	*EE*	272	123	180	82	6.79	172.5	3.77	143
4	102	380	172	"	519	235	350	159	5.39	136.9	1.54	141
5	127	525	238	"	894	406	600	272	4.33	110.0	.721	142
6	152	730	331	"	1487	674	1000	454	3.64	92.5	.364	143
7	178	979	444	"	2277	1033	1500	680	3.09	78.5	.206	144
8	203	1156	524	"	2982	1352	2000	907	2.78	70.6	.139	146
9	229	1302	591	"	3782	1716	2500	1134	2.45	62.2	.0979	146
10	254	1462	663	"	4797	2176	3200	1451	2.21	56.1	.0691	146
11	279	1615	733	"	5800	2631	3900	1769	2.04	51.8	.0522	146
12	305	1761	799	"	6899	3129	4500	2041	1.82	46.2	.0405	146
13	330	1936	878	"	8407	3813	5500	2495	1.66	42.2	.0302	146

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—26 Feet (7.925 meters)

Sections: 18 feet 6 inches, 6 feet 6 inches and 4 feet (5.638 meters, 1.981 meters and 1.219 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
7245	4	102	272	123	*fff*	391	177	250	113	5.28	134.1	2.11	134
7246	5	127	371	168	"	663	301	450	204	4.49	114.0	.998	137
7247	6	152	490	222	"	1033	469	700	318	3.74	95.0	.534	139
7248	7	178	617	280	"	1484	673	1000	454	3.21	81.5	.321	141
7249	8	203	758	344	"	2044	927	1400	635	2.87	72.9	.205	142
7250	9	229	907	411	"	2719	1233	1800	816	2.48	63.0	.138	143
7251	10	254	1084	492	"	3638	1650	2400	1089	2.22	56.4	.0924	143
7252	11	279	1243	564	"	4493	2038	3000	1361	2.04	51.8	.0681	145
7253	12	305	1376	624	"	5330	2418	3600	1633	1.90	48.3	.0527	145
7254	13	330	1515	687	"	6478	2938	4200	1905	1.66	42.2	.0396	146
7255	4	102	350	159	*Eff*	519	235	350	159	5.71	145.0	1.63	129
7256	5	127	480	218	"	894	406	600	272	4.55	115.6	.758	131
7257	6	152	667	303	"	1487	674	1000	454	3.81	96.8	.381	132
7258	7	178	885	401	"	2277	1033	1500	680	3.23	82.0	.215	133
7259	8	203	1032	468	"	2982	1352	2000	907	2.88	73.2	.144	136
7260	9	229	1181	536	"	3782	1716	2500	1134	2.53	64.3	.101	137
7261	10	254	1347	611	"	4797	2176	3200	1451	2.28	57.9	.0711	139
7262	11	279	1511	685	"	5800	2631	3900	1769	2.09	53.1	.0535	141
7263	12	305	1668	757	"	6899	3129	4500	2041	1.86	47.2	.0413	141
7264	13	330	1839	834	"	8407	3813	5500	2495	1.70	43.2	.0309	141
7265	4	102	368	167	*EEf*	519	235	350	159	5.57	141.5	1.59	134
7266	5	127	507	230	"	894	406	600	272	4.45	113.0	.741	136
7267	6	152	706	320	"	1487	674	1000	454	3.73	94.7	.373	137
7268	7	178	947	430	"	2277	1033	1500	680	3.15	80.0	.210	140
7269	8	203	1126	511	"	2982	1353	2000	907	2.80	71.1	.140	142
7270	9	229	1277	579	"	3782	1716	2500	1134	2.47	62.7	.0988	143
7271	10	254	1443	655	"	4797	2176	3200	1451	2.23	56.6	.0698	143
7272	11	279	1603	727	"	5800	2631	3900	1769	2.06	52.3	.0527	145
7273	12	305	1763	800	"	6899	3129	4500	2041	1.84	46.7	.0408	145
7274	13	330	1941	880	"	8407	3813	5500	2495	1.67	42.4	.0304	143
7275	4	102	375	170	*EEE*	519	235	350	159	5.57	141.5	1.59	134
7276	5	127	518	235	"	894	406	600	272	4.45	113.0	.741	136
7277	6	152	722	327	"	1487	674	1000	454	3.72	94.5	.372	138
7278	7	178	971	440	"	2277	1033	1500	680	3.15	80.0	.210	140
7279	8	203	1164	528	"	2982	1352	2000	907	2.80	71.1	.140	143
7280	9	229	1335	606	"	3782	1716	2500	1134	2.47	62.7	.0988	143
7281	10	254	1502	681	"	4797	2176	3200	1451	2.23	56.6	.0698	144
7282	11	279	1662	754	"	5800	2631	3900	1769	2.06	52.3	.0527	145
7283	12	305	1819	825	"	6899	3129	4500	2041	1.84	46.7	.0408	146
7284	13	330	1999	907	"	8407	3813	5500	2495	1.67	42.4	.0304	143

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—27 Feet (8.230 meters)

Sections: 18 feet 6 inches and 10 feet (5.638 meters and 3.048 meters)

Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
3	76	198	90	*ff*	199	90	130	59	7.70	195.6	5.92	145
4	102	276	125	"	371	168	250	113	6.30	160.0	2.52	141
5	127	378	171	"	629	285	400	181	4.72	119.9	1.18	144
6	152	498	226	"	980	445	650	295	4.10	104.1	.631	146
7	178	625	283	"	1408	639	950	431	3.59	91.2	.378	148
8	203	764	347	"	1940	880	1300	590	3.15	80.0	.242	149
9	229	913	414	"	2580	1170	1700	771	2.75	69.8	.162	150
10	254	1088	494	"	3451	1565	2300	1043	2.51	63.8	.109	150
11	279	1249	567	"	4262	1933	2800	1270	2.24	56.9	.0800	152
12	305	1374	623	"	5057	2294	3400	1542	2.10	53.3	.0619	152
13	330	1506	683	"	6146	2788	4000	1814	1.86	47.2	.0465	152
3	76	249	113	*Ef*	258	117	170	77	7.96	202.2	4.68	139
4	102	353	160	"	493	224	350	159	6.86	174.2	1.96	134
5	127	487	221	"	848	385	550	249	4.98	126.5	.906	137
6	152	675	306	"	1410	640	950	431	4.32	109.7	.455	138
7	178	893	405	"	2160	980	1400	635	3.58	90.9	.256	140
8	203	1038	471	"	2829	1283	1900	862	3.25	82.5	.171	142
9	229	1187	538	"	3588	1627	2400	1089	2.88	73.2	.120	144
10	254	1351	613	"	4551	2064	3000	1361	2.53	64.3	.0842	145
11	279	1517	688	"	5503	2496	3700	1678	2.33	59.2	.0631	148
12	305	1666	756	"	6545	2969	4500	2041	2.19	55.6	.0486	147
13	330	1830	830	"	7976	3618	5200	2359	1.90	48.3	.0365	147
3	76	267	121	*EE*	258	117	170	77	7.77	197.4	4.57	144
4	102	381	173	"	493	224	350	159	6.65	168.9	1.90	140
5	127	529	240	"	848	385	550	249	4.83	122.7	.879	143
6	152	734	333	"	1410	640	950	431	4.19	106.4	.441	145
7	178	989	449	"	2160	980	1400	635	3.47	88.1	.248	147
8	203	1183	537	"	2829	1283	1900	862	3.14	79.8	.165	150
9	229	1335	606	"	3588	1627	2400	1089	2.78	70.6	.116	151
10	254	1499	680	"	4551	2064	3000	1361	2.47	62.7	.0822	151
11	279	1659	752	"	5503	2496	3700	1678	2.29	58.2	.0619	152
12	305	1811	821	"	6545	2969	4500	2041	2.16	54.9	.0479	152
13	330	1988	902	"	7976	3618	5200	2359	1.86	47.2	.0358	151

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—27 Feet (8.230 meters)

Sections: 18 feet 6 inches, 6 feet 6 inches and 5 feet (5.638 meters, 1.9
meters and 1.524 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load P		Load for Deflection D L		Deflection for Load L D		Factor R
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m	
7318	4	102	278	126	*fff*	371	168	250	113	6.30	160.0	2.52
7319	5	127	378	171	"	629	285	400	181	4.76	120.9	1.19
7320	6	152	500	227	"	980	445	650	295	4.11	104.4	.632
7321	7	178	631	286	"	1408	639	950	431	3.60	91.4	.379
7322	8	203	777	352	"	1940	880	1300	590	3.15	80.0	.242
7323	9	229	931	422	"	2580	1170	1700	771	2.77	70.4	.163
7324	10	254	1113	505	"	3451	1565	2300	1043	2.51	63.8	.109
7325	11	279	1276	579	"	4262	1933	2800	1270	2.24	56.9	.0801
7326	12	305	1417	643	"	5057	2294	3400	1542	2.11	53.6	.0620
7327	13	330	1561	708	"	6146	2788	4000	1814	1.86	47.2	.0465
7328	4	102	356	161	*Eff*	493	224	350	159	6.86	174.2	1.96
7329	5	127	487	221	"	848	385	550	249	5.01	127.3	.910
7330	6	152	678	308	"	1410	640	950	431	4.33	110.0	.456
7331	7	178	900	408	"	2160	980	1400	635	3.60	91.4	.257
7332	8	203	1051	477	"	2829	1283	1900	862	3.25	82.5	.171
7333	9	229	1204	546	"	3588	1627	2400	1089	2.88	73.2	.120
7334	10	254	1375	624	"	4551	2064	3000	1361	2.53	64.3	.0844
7335	11	279	1545	701	"	5503	2496	3700	1678	2.34	59.4	.0632
7336	12	305	1709	775	"	6545	2969	4500	2041	2.19	55.6	.0487
7337	13	330	1884	855	"	7976	3618	5200	2359	1.90	48.3	.0365
7338	4	102	374	170	*EEf*	493	224	350	159	6.65	168.9	1.90
7339	5	127	515	234	"	848	385	550	249	4.86	123.4	.883
7340	6	152	716	325	"	1410	640	950	431	4.21	106.9	.443
7341	7	178	962	436	"	2160	980	1400	635	3.49	88.6	.249
7342	8	203	1145	519	"	2829	1283	1900	862	3.15	80.0	.166
7343	9	229	1301	590	"	3588	1627	2400	1089	2.81	71.4	.117
7344	10	254	1472	668	"	4551	2064	3000	1361	2.47	62.7	.0823
7345	11	279	1637	743	"	5503	2496	3700	1678	2.29	58.2	.0620
7346	12	305	1803	818	"	6545	2969	4500	2041	2.16	54.9	.0479
7347	13	330	1987	901	"	7976	3618	5200	2359	1.87	47.5	.0359
7348	4	102	383	174	*EEE*	493	224	350	159	6.65	168.9	1.90
7349	5	127	528	240	"	848	385	550	249	4.85	123.2	.882
7350	6	152	737	334	"	1410	640	950	431	4.20	106.7	.442
7351	7	178	991	450	"	2160	980	1400	635	3.47	88.1	.248
7352	8	203	1193	541	"	2829	1283	1900	862	3.14	79.8	.165
7353	9	229	1373	623	"	3588	1627	2400	1089	2.81	71.4	.117
7354	10	254	1546	701	"	4551	2064	3000	1361	2.47	62.7	.0822
7355	11	279	1711	776	"	5503	2496	3700	1678	2.29	58.2	.0619
7356	12	305	1874	850	"	6545	2969	4500	2041	2.16	54.9	.0479
7357	13	330	2060	934	"	7976	3618	5200	2359	1.87	47.5	.0359

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—28 Feet (8.534 meters)

Sections: 19 feet and 10 feet 6 inches (5.791 meters and 3.200 meters)

Size of Butt		Weight		Thickness	Maximum Load P		Load for Deflection D L		Deflection for Load L D		Factor R	Factor m
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
3	76	205	93	*ff*	189	86	130	59	8.96	228.	6.89	152
4	102	285	129	"	352	160	220	100	6.45	164.	2.93	148
5	127	391	177	"	598	271	400	181	5.52	140.	1.38	151
6	152	514	233	"	932	423	600	272	4.41	112.	.735	153
7	178	646	293	"	1339	607	900	408	3.96	101.	.440	156
8	203	790	358	"	1845	837	1200	544	3.37	85.6	.281	157
9	229	944	428	"	2454	1113	1600	726	3.02	76.7	.189	158
10	254	1126	511	"	3283	1489	2200	998	2.79	70.9	.127	158
11	279	1292	586	"	4054	1839	2700	1225	2.51	63.8	.0931	160
12	305	1421	645	"	4810	2182	3200	1451	2.30	58.4	.0720	160
13	330	1558	707	"	5846	2652	3900	1769	2.11	53.6	.0541	159
3	76	257	117	*Ef*	245	111	160	73	8.74	222.	5.46	146
4	102	365	166	"	468	212	300	136	6.87	174.	2.29	141
5	127	503	228	"	807	366	550	249	5.83	148.	1.06	144
6	152	697	316	"	1342	609	900	408	4.77	121.	.530	145
7	178	922	418	"	2055	932	1400	635	4.19	106.	.299	146
8	203	1071	486	"	2691	1221	1800	816	3.58	90.9	.199	149
9	229	1226	556	"	3413	1548	2300	1043	3.22	81.8	.140	151
10	254	1395	633	"	4329	1964	2900	1315	2.84	72.1	.0980	152
11	279	1567	711	"	5234	2374	3500	1588	2.57	65.3	.0735	155
12	305	1721	781	"	6226	2824	4200	1905	2.38	60.5	.0567	155
13	330	1891	858	"	7587	3441	5000	2268	2.13	54.1	.0426	155
3	76	276	125	*EE*	245	111	160	73	8.53	217.	5.33	151
4	102	393	178	"	468	212	300	136	6.63	168.	2.21	147
5	127	547	248	"	807	366	550	249	5.61	142.	1.02	150
6	152	759	344	"	1342	609	900	408	4.63	118.	.514	152
7	178	1022	464	"	2055	932	1400	635	4.06	103.	.289	154
8	203	1224	555	"	2691	1221	1800	816	3.46	87.9	.192	158
9	229	1381	626	"	3413.	1548	2300	1043	3.11	79.0	.135	159
10	254	1551	704	"	4329	1964	2900	1315	2.77	70.4	.0956	159
11	279	1716	778	"	5234	2374	3500	1588	2.52	64.0	.0720	160
12	305	1874	850	"	6226	2824	4200	1905	2.34	59.4	.0557	160
13	330	2057	933	"	7587	3441	5000	2268	2.09	53.1	.0417	160

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—28 Feet (8.534 meters)

Sections: 19 feet, 7 feet and 5 feet (5.791 meters, 2.134 meters and 1.524 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
7391	4	102	287	130	*fff*	352	160	220	100	6.47	164.	2.94	145
7392	5	127	391	177	"	598	271	400	181	5.52	140.	1.38	148
7393	6	152	517	235	"	932	423	600	272	4.42	112.	.736	151
7394	7	178	653	296	"	1339	607	900	408	3.97	101.	.441	154
7395	8	203	803	364	"	1845	837	1200	544	3.38	85.8	.282	156
7396	9	229	962	436	"	2454	1113	1600	726	3.02	76.7	.189	157
7397	10	254	1150	522	"	3283	1489	2200	998	2.79	70.9	.127	157
7398	11	279	1319	598	"	4054	1839	2700	1225	2.52	64.0	.0932	159
7399	12	305	1464	664	"	4810	2182	3200	1451	2.30	58.4	.0720	159
7400	13	330	1613	732	"	5846	2652	3900	1769	2.11	53.6	.0541	159
7401	4	102	367	166	*Eff*	468	212	300	136	6.87	174.	2.29	138
7402	5	127	503	228	"	807	366	550	249	5.83	148.	1.06	140
7403	6	152	700	318	"	1342	609	900	408	4.79	122.	.532	142
7404	7	178	928	421	"	2055	932	1400	635	4.20	107.	.300	144
7405	8	203	1084	492	"	2691	1221	1800	816	3.60	91.4	.200	147
7406	9	229	1243	564	"	3413	1548	2300	1043	3.22	81.8	.140	150
7407	10	254	1420	644	"	4329	1964	2900	1315	2.84	72.1	.0981	151
7408	11	279	1595	723	"	5234	2374	3500	1588	2.58	65.5	.0736	154
7409	12	305	1764	800	"	6226	2824	4200	1905	2.38	60.5	.0567	154
7410	13	330	1945	882	"	7587	3441	5000	2268	2.13	54.1	.0426	155
7411	4	102	386	175	*EEf*	468	212	300	136	6.66	169.	2.22	143
7412	5	127	532	241	"	807	366	550	249	5.67	144.	1.03	145
7413	6	152	741	336	"	1342	609	900	408	4.64	118.	.515	148
7414	7	178	995	451	"	2055	932	1400	635	4.05	103.	.289	151
7415	8	203	1186	538	"	2691	1221	1800	816	3.47	88.1	.193	155
7416	9	229	1347	611	"	3413	1548	2300	1043	3.13	79.5	.136	156
7417	10	254	1523	691	"	4329	1964	2900	1315	2.78	70.6	.0957	156
7418	11	279	1694	768	"	5234	2374	3500	1588	2.52	64.0	.0720	158
7419	12	305	1866	846	"	6226	2824	4200	1905	2.34	59.4	.0557	159
7420	13	330	2056	933	"	7587	3441	5000	2268	2.09	53.1	.0418	159
7421	4	102	395	179	*EEE*	468	212	300	136	6.66	169.	2.22	144
7422	5	127	546	248	"	807	366	550	249	5.67	144.	1.03	147
7423	6	152	762	346	"	1342	609	900	408	4.64	118.	.515	149
7424	7	178	1025	465	"	2055	932	1400	635	4.05	103.	.289	152
7425	8	203	1234	560	"	2691	1221	1800	816	3.46	87.9	.192	156
7426	9	229	1419	644	"	3413	1548	2300	1043	3.13	79.5	.136	158
7427	10	254	1597	724	"	4329	1964	2900	1315	2.77	70.4	.0956	157
7428	11	279	1768	802	"	5234	2374	3500	1588	2.52	64.0	.0720	159
7429	12	305	1937	879	"	6226	2824	4200	1905	2.34	59.4	.0557	160
7430	13	330	2128	965	"	7587	3441	5000	2268	2.09	53.1	.0418	160

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—28 Feet (8.534 meters)

Sections: 21 feet, 5 feet and 5 feet (6.401 meters, 1.524 meters and 1.524 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
	Ins.	m/n	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
7431	4	102	294	133	*fff*	352	160	220	100	6.20	157.	2.82	150
7432	5	127	399	181	"	598	271	400	181	5.36	136.	1.34	152
7433	6	152	526	239	"	932	423	600	272	4.31	109.	.718	155
7434	7	178	662	300	"	1339	607	900	408	3.90	99.1	.433	156
7435	8	203	813	369	"	1845	837	1200	544	3.34	84.8	.278	158
7436	9	229	972	441	"	2454	1113	1600	726	2.98	75.7	.186	159
7437	10	254	1163	528	"	3283	1489	2200	998	2.75	69.9	.125	159
7438	11	279	1330	603	"	4054	1839	2700	1225	2.49	63.2	.0921	160
7439	12	305	1472	668	"	4810	2182	3200	1451	2.29	58.2	.0715	161
7440	13	330	1623	736	"	5846	2652	3900	1769	2.09	53.1	.0537	161
7441	4	102	382	173	*Eff*	468	212	300	136	6.48	165.	2.16	144
7442	5	127	522	237	"	807	366	550	249	5.56	141.	1.01	146
7443	6	152	728	330	"	1342	609	900	408	4.56	116.	.507	148
7444	7	178	966	438	"	2055	932	1400	635	4.02	102.	.287	150
7445	8	203	1124	510	"	2691	1221	1800	816	3.47	88.1	.193	152
7446	9	229	1283	582	"	3413	1548	2300	1043	3.13	79.5	.136	154
7447	10	254	1461	663	"	4329	1964	2900	1315	2.77	70.4	.0956	155
7448	11	279	1634	741	"	5234	2374	3500	1588	2.52	64.0	.0719	157
7449	12	305	1804	818	"	6226	2824	4200	1905	2.34	59.4	.0556	158
7450	13	330	1990	903	"	7587	3441	5000	2268	2.08	52.8	.0416	157
7451	4	102	396	180	*EEf*	468	212	300	136	6.39	162.	2.13	148
7452	5	127	543	246	"	807	366	550	249	5.48	139.	.996	150
7453	6	152	757	343	"	1342	609	900	408	4.51	115.	.501	152
7454	7	178	1014	460	"	2055	932	1400	635	3.96	101.	.283	154
7455	8	203	1196	543	"	2691	1221	1800	816	3.42	86.9	.190	157
7456	9	229	1357	616	"	3413	1548	2300	1043	3.08	78.2	.134	158
7457	10	254	1535	696	"	4329	1964	2900	1315	2.74	69.6	.0946	159
7458	11	279	1705	773	"	5234	2374	3500	1588	2.50	63.5	.0714	159
7459	12	305	1876	851	"	6226	2824	4200	1905	2.32	58.9	.0553	160
7460	13	330	2069	938	"	7587	3441	5000	2268	2.07	52.6	.0413	159
7461	4	102	405	184	*EEE*	468	212	300	136	6.39	162.	2.13	150
7462	5	127	557	253	"	807	366	550	249	5.47	139.	.995	151
7463	6	152	778	353	"	1342	609	900	408	4.50	114.	.500	153
7464	7	178	1044	474	"	2055	932	1400	635	3.96	101.	.283	156
7465	8	203	1244	564	"	2691	1221	1800	816	3.42	86.9	.190	158
7466	9	229	1430	649	"	3413	1548	2300	1043	3.08	78.2	.134	160
7467	10	254	1609	730	"	4329	1964	2900	1315	2.74	69.6	.0945	160
7468	11	279	1779	807	"	5234	2374	3500	1588	2.50	63.5	.0713	160
7469	12	305	1947	883	"	6226	2824	4200	1905	2.32	58.9	.0552	161
7470	13	330	2142	972	"	7587	3441	5000	2268	2.07	52.6	.0413	160

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—29 Feet (8.839 meters)

Sections: 20 feet and 10 feet 6 inches (6.096 meters and 3.200 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Facto *m*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
7471	3	76	212	96	*ff*	180	82	120	54	9.48	241.	7.90	160
7472	4	102	296	134	"	336	152	220	100	7.37	187.	3.35	156
7473	5	127	405	184	"	570	259	400	181	6.32	161.	1.58	159
7474	6	152	533	242	"	889	403	600	272	5.06	129.	.843	161
7475	7	178	670	304	"	1277	579	850	386	4.30	109.	.506	164
7476	8	203	819	371	"	1759	798	1200	544	3.88	98.5	.323	165
7477	9	229	978	444	"	2340	1061	1600	726	3.47	88.1	.217	166
7478	10	254	1167	529	"	3130	1420	2100	953	3.05	77.5	.145	166
7479	11	279	1337	606	"	3866	1754	2600	1179	2.78	70.6	.107	168
7480	12	305	1471	667	"	4587	2081	3100	1406	2.57	65.3	.0830	168
7481	13	330	1613	732	"	5574	2528	3700	1678	2.31	58.7	.0623	167
7482	3	76	267	121	*Ef*	234	106	160	73	9.98	254.	6.24	154
7483	4	102	380	172	"	447	203	300	136	7.80	198.	2.60	149
7484	5	127	523	237	"	769	349	500	227	6.05	154.	1.21	152
7485	6	152	725	329	"	1279	580	850	386	5.15	131.	.606	153
7486	7	178	960	435	"	1959	889	1300	590	4.45	113.	.342	154
7487	8	203	1115	506	"	2566	1164	1700	771	3.88	98.6	.228	157
7488	9	229	1274	578	"	3254	1476	2200	998	3.52	89.4	.160	159
7489	10	254	1450	658	"	4127	1872	2800	1270	3.14	79.8	.112	160
7490	11	279	1627	738	"	4991	2264	3300	1497	2.79	70.9	.0844	163
7491	12	305	1787	811	"	5936	2692	4000	1814	2.60	66.0	.0651	164
7492	13	330	1963	890	"	7234	3281	4800	2177	2.34	59.4	.0488	163
7493	3	76	286	130	*EE*	234	106	160	73	9.78	248.	6.11	160
7494	4	102	408	185	"	447	203	300	136	7.59	193.	2.53	155
7495	5	127	568	258	"	769	349	500	227	5.85	149.	1.17	159
7496	6	152	787	357	"	1279	580	850	386	5.01	127.	.589	160
7497	7	178	1060	481	"	1959	889	1300	590	4.30	109.	.331	163
7498	8	203	1267	575	"	2566	1164	1700	771	3.76	95.5	.221	166
7499	9	229	1430	649	"	3254	1476	2200	998	3.43	87.1	.156	167
7500	10	254	1605	728	"	4127	1872	2800	1270	3.08	78.2	.110	167
7501	11	279	1776	806	"	4991	2264	3300	1497	2.74	69.6	.0829	168
7502	12	305	1939	879	"	5936	2692	4000	1814	2.57	65.3	.0642	169
7503	13	330	2129	966	"	7234	3281	4800	2177	2.30	58.4	.0480	167

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—29 Feet (8.839 meters)

Sections: 18 feet 6 inches, 7 feet and 6 feet 6 inches (5.638 meters, 2.134 meters and 1.981 meters)

Size of Butt		Weight		Thickness	Maximum Load P		Load for Deflection D		Deflection for Load L		Factor R	Factor m
							L		D			
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
4	102	291	132	*fff*	336	152	220	100	7.74	197.	3.52	147
5	127	395	179	"	570	259	400	181	6.60	168.	1.65	148
6	152	524	238	"	889	403	600	272	5.23	133.	.872	153
7	178	663	301	"	1277	579	850	386	4.41	112.	.519	158
8	203	817	371	"	1759	798	1200	544	3.96	101.	.330	160
9	229	980	445	"	2340	1061	1600	726	3.54	89.9	.221	161
10	254	1173	532	"	3130	1420	2100	953	3.11	79.0	.148	162
11	279	1348	611	"	3866	1754	2600	1179	2.83	71.9	.109	164
12	305	1500	680	"	4587	2081	3100	1406	2.60	66.0	.0838	165
13	330	1654	750	"	5574	2528	3700	1678	2.33	59.2	.0630	165
4	102	368	167	*Eff*	447	203	300	136	8.40	213.	2.80	138
5	127	504	229	"	769	349	500	227	6.45	164.	1.29	139
6	152	702	318	"	1279	580	850	386	5.46	139.	.642	143
7	178	931	422	"	1959	889	1300	590	4.68	119.	.360	146
8	203	1091	495	"	2566	1164	1700	771	4.05	103.	.238	150
9	229	1254	569	"	3254	1476	2200	998	3.65	92.7	.166	153
10	254	1435	651	"	4127	1872	2800	1270	3.25	82.5	.116	155
11	279	1616	733	"	4991	2264	3300	1497	2.86	72.6	.0866	158
12	305	1792	813	"	5936	2692	4000	1814	2.66	67.6	.0665	159
13	330	1978	897	"	7234	3281	4800	2177	2.40	61.0	.0501	160
4	102	387	176	*EEf*	447	203	300	136	8.04	204.	2.68	142
5	127	534	242	"	769	349	500	227	6.15	156.	1.23	144
6	152	743	337	"	1279	580	850	386	5.23	133.	.615	148
7	178	998	453	"	1959	889	1300	590	4.46	113.	.343	152
8	203	1192	541	"	2566	1164	1700	771	3.84	97.5	.226	157
9	229	1358	616	"	3254	1476	2200	998	3.50	88.9	.159	159
10	254	1539	698	"	4127	1872	2800	1270	3.14	79.8	.112	160
11	279	1715	778	"	4991	2264	3300	1497	2.78	70.6	.0842	162
12	305	1894	859	"	5936	2692	4000	1814	2.60	66.0	.0649	164
13	330	2088	947	"	7234	3281	4800	2177	2.34	59.4	.0487	164
4	102	399	181	*EEE*	447	203	300	136	7.98	203.	2.66	145
5	127	551	250	"	769	349	500	227	6.15	156.	1.23	147
6	152	770	349	"	1279	580	850	386	5.20	132.	.612	151
7	178	1037	470	"	1959	889	1300	590	4.43	113.	.341	155
8	203	1255	569	"	2566	1164	1700	771	3.83	97.3	.225	161
9	229	1452	659	"	3254	1476	2200	998	3.48	88.4	.158	163
10	254	1635	742	"	4127	1872	2800	1270	3.14	79.8	.112	163
11	279	1811	821	"	4991	2264	3300	1497	2.77	70.4	.0839	165
12	305	1986	901	"	5936	2692	4000	1814	2.59	65.8	.0648	166
13	330	2182	990	"	7234	3281	4800	2177	2.33	59.2	.0486	166

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—29 Feet (8.839 meters)

Sections: 21 feet, 7 feet and 4 feet (6.401 meters, 2.134 meters and 1.219 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
7544	4	102	303	137	*fff*	336	152	220	100	7.24	184.	3.29	158
7545	5	127	413	187	"	570	259	400	181	6.24	158.	1.56	160
7546	6	152	544	247	"	889	403	600	272	5.00	127.	.833	163
7547	7	178	685	311	"	1277	579	850	386	4.26	108.	.501	165
7548	8	203	841	381	"	1759	798	1200	544	3.85	97.8	.321	166
7549	9	229	1006	456	"	2340	1061	1600	726	3.46	87.9	.216	167
7550	10	254	1202	545	"	3130	1420	2100	953	3.02	76.7	.144	166
7551	11	279	1377	625	"	3866	1754	2600	1179	2.78	70.6	.107	168
7552	12	305	1523	691	"	4587	2081	3100	1406	2.56	65.0	.0827	169
7553	13	330	1676	760	"	5574	2528	3700	1678	2.29	58.2	.0620	168
7554	4	102	391	177	*Eff*	447	203	300	136	7.59	193.	2.53	151
7555	5	127	536	243	"	769	349	500	227	5.90	150.	1.18	154
7556	6	152	746	338	"	1279	580	850	386	5.03	128.	.592	155
7557	7	178	989	449	"	1959	889	1300	590	4.36	111.	.335	157
7558	8	203	1152	523	"	2566	1164	1700	771	3.81	96.8	.224	159
7559	9	229	1317	597	"	3254	1476	2200	998	3.48	88.4	.158	161
7560	10	254	1500	680	"	4127	1872	2800	1270	3.11	79.0	.111	162
7561	11	279	1681	762	"	4991	2264	3300	1497	2.75	69.8	.0834	164
7562	12	305	1855	841	"	5936	2692	4000	1814	2.58	65.5	.0646	165
7563	13	330	2044	927	"	7234	3281	4800	2177	2.32	58.9	.0483	164
7564	4	102	410	186	*EEf*	447	203	300	136	7.44	189.	2.48	157
7565	5	127	566	257	"	769	349	500	227	5.80	147.	1.16	159
7566	6	152	787	357	"	1279	580	850	386	4.94	125.	.581	161
7567	7	178	1057	479	"	1959	889	1300	590	4.26	108.	.328	163
7568	8	203	1253	568	"	2566	1164	1700	771	3.74	95.0	.220	166
7569	9	229	1421	645	"	3254	1476	2200	998	3.41	86.6	.155	167
7570	10	254	1604	728	"	4127	1872	2800	1270	3.05	77.5	.109	167
7571	11	279	1781	808	"	4991	2264	3300	1497	2.72	69.1	.0824	168
7572	12	305	1956	887	"	5936	2692	4000	1814	2.56	65.0	.0639	169
7573	13	330	2154	977	"	7234	3281	4800	2177	2.29	58.2	.0477	168
7574	4	102	418	190	*EEE*	447	203	300	136	7.44	189.	2.48	157
7575	5	127	577	262	"	769	349	500	227	5.75	146.	1.15	160
7576	6	152	804	365	"	1279	580	850	386	4.94	125.	.581	161
7577	7	178	1080	490	"	1959	889	1300	590	4.26	108.	.328	164
7578	8	203	1292	586	"	2566	1164	1700	771	3.74	95.0	.220	167
7579	9	229	1479	671	"	3254	1476	2200	998	3.41	86.6	.155	168
7580	10	254	1663	754	"	4127	1872	2800	1270	3.05	77.5	.109	167
7581	11	279	1840	835	"	4991	2264	3300	1497	2.72	69.1	.0824	168
7582	12	305	2013	913	"	5936	2692	4000	1814	2.56	65.0	.0639	169
7583	13	330	2213	1004	"	7234	3281	4800	2177	2.29	58.2	.0478	168

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—30 Feet (9.144 meters)

Sections: 21 feet and 10 feet 6 inches (6.401 meters and 3.200 meters)

Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
3	76	220	100	*ff*	172	78	110	50	9.91	252.	9.01	168
4	102	306	139	"	321	146	220	100	8.40	213.	3.82	164
5	127	420	191	"	545	247	350	159	6.30	160.	1.80	167
6	152	552	250	"	849	385	550	249	5.29	134.	.962	170
7	178	693	314	"	1220	553	800	363	4.62	117.	.578	172
8	203	847	384	"	1681	762	1100	499	4.06	103.	.369	173
9	229	1012	459	"	2236	1014	1500	680	3.72	94.5	.248	174
10	254	1207	547	"	2991	1357	2000	907	3.32	84.3	.166	174
11	279	1383	627	"	3694	1676	2500	1134	3.08	78.2	.123	176
12	305	1520	689	"	4383	1988	2900	1315	2.75	69.8	.0949	176
13	330	1667	756	"	5326	2416	3600	1633	2.57	65.3	.0713	176
3	76	277	126	*Ef*	223	101	150	68	10.6	269.	7.09	162
4	102	395	179	"	427	194	280	127	8.26	210.	2.95	157
5	127	544	247	"	735	333	500	227	6.85	174.	1.37	160
6	152	754	342	"	1222	554	800	363	5.50	140.	.688	161
7	178	998	453	"	1872	849	1200	544	4.67	119.	.389	163
8	203	1158	525	"	2452	1112	1600	726	4.16	106.	.260	165
9	229	1323	600	"	3110	1411	2100	953	3.82	97.0	.182	167
10	254	1505	683	"	3944	1789	2600	1179	3.33	84.6	.128	168
11	279	1687	765	"	4769	2163	3200	1451	3.08	78.2	.0963	171
12	305	1852	840	"	5672	2573	3800	1724	2.82	71.6	.0743	171
13	330	2035	923	"	6913	3136	4500	2041	2.51	63.8	.0557	171
3	76	297	135	*EE*	223	101	150	68	10.4	264.	6.96	168
4	102	423	192	"	427	194	280	127	8.06	205.	2.88	163
5	127	588	267	"	735	333	500	227	6.70	170.	1.34	167
6	152	816	370	"	1222	554	800	363	5.38	137.	.672	168
7	178	1098	498	"	1872	849	1200	544	4.54	115.	.378	171
8	203	1310	594	"	2452	1112	1600	726	4.05	103.	.253	174
9	229	1478	670	"	3110	1411	2100	953	3.74	95.0	.178	175
10	254	1660	753	"	3944	1789	2600	1179	3.28	83.3	.126	175
11	279	1836	833	"	4769	2163	3200	1451	3.03	77.0	.0948	176
12	305	2005	909	"	5672	2573	3800	1724	2.79	70.9	.0734	176
13	330	2201	998	"	6913	3136	4500	2041	2.47	62.7	.0549	175

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—30 Feet (9.144 meters)

Sections: 18 feet 6 inches, 9 feet 6 inches and 5 feet (5.638 meters, 2.895 meters and 1.524 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
7617	4	102	301	137	*fff*	321	146	220	100	8.98	228.	4.08	156
7618	5	127	411	186	"	545	247	350	159	6.65	169.	1.90	159
7619	6	152	544	247	"	849	385	550	249	5.50	140.	1.00	164
7620	7	178	688	312	"	1220	553	800	363	4.78	121.	.597	167
7621	8	203	847	384	"	1681	762	1100	499	4.18	106.	.380	169
7622	9	229	1016	461	"	2236	1014	1500	680	3.81	96.8	.254	170
7623	10	254	1214	551	"	2991	1357	2000	907	3.42	86.9	.171	170
7624	11	279	1398	634	"	3694	1676	2500	1134	3.13	79.5	.125	173
7625	12	305	1553	704	"	4383	1988	2900	1315	2.79	70.9	.0963	174
7626	13	330	1709	775	"	5326	2416	3600	1633	2.61	66.3	.0724	173
7627	4	102	379	172	*Eff*	388	176	250	113	8.15	207.	3.26	148
7628	5	127	520	236	"	723	328	500	227	7.45	189.	1.49	150
7629	6	152	722	327	"	1222	554	800	363	5.96	151.	.745	153
7630	7	178	957	434	"	1872	849	1200	544	5.02	128.	.418	155
7631	8	203	1121	509	"	2452	1112	1600	726	4.42	112.	.276	159
7632	9	229	1290	585	"	3110	1411	2100	953	4.03	102.	.192	162
7633	10	254	1477	670	"	3944	1789	2600	1179	3.48	88.4	.134	163
7634	11	279	1666	756	"	4769	2163	3200	1451	3.20	81.3	.100	166
7635	12	305	1846	837	"	5672	2573	3800	1724	2.92	74.2	.0768	167
7636	13	330	2033	922	"	6913	3136	4500	2041	2.60	66.0	.0577	166
7637	4	102	404	183	*EEf*	427	194	280	127	8.65	220.	3.09	154
7638	5	127	560	254	"	735	333	500	227	7.05	179.	1.41	158
7639	6	152	778	353	"	1222	554	800	363	5.65	144.	.706	160
7640	7	178	1048	475	"	1872	849	1200	544	4.72	120.	.393	164
7641	8	203	1259	571	"	2452	1112	1600	726	4.14	105.	.259	169
7642	9	229	1431	649	"	3110	1411	2100	953	3.82	97.0	.182	170
7643	10	254	1618	734	"	3944	1789	2600	1179	3.35	85.1	.129	171
7644	11	279	1801	817	"	4769	2163	3200	1451	3.08	78.2	.0964	172
7645	12	305	1983	899	"	5672	2573	3800	1724	2.83	71.9	.0744	173
7646	13	330	2183	990	"	6913	3136	4500	2041	2.52	64.0	.0559	172
7647	4	102	414	188	*EEE*	427	194	280	127	8.62	219.	3.08	156
7648	5	127	573	260	"	735	333	500	227	7.05	179.	1.41	159
7649	6	152	799	362	"	1222	554	800	363	5.64	143.	.705	162
7650	7	178	1077	489	"	1872	849	1200	544	4.72	120.	.393	165
7651	8	203	1307	593	"	2452	1112	1600	726	4.14	105.	.259	170
7652	9	229	1503	682	"	3110	1411	2100	953	3.82	97.0	.182	172
7653	10	254	1692	768	"	3944	1789	2600	1179	3.33	84.6	.128	172
7654	11	279	1875	851	"	4769	2163	3200	1451	3.08	78.2	0963	173
7655	12	305	2054	932	"	5672	2573	3800	1724	2.83	71.9	0744	174
7656	13	330	2256	1023	"	6913	3136	4500	2041	2.52	64.0	.0559	173

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—30 Feet (9.144 meters)

ctions: 19 feet, 7 feet and 7 feet (5.791 meters, 2.134 meters and 2.134 meters)

Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D*		Deflection for Load *L*		Factor *R*	Factor *m*
							L		*D*			
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
4	102	299	136	*fff*	321	146	220	100	8.93	227.	4.06	152
5	127	406	184	"	545	247	350	159	6.65	169.	1.90	154
6	152	539	244	"	849	385	550	249	5.50	140.	1.00	159
7	178	682	309	"	1220	553	800	363	4.77	121.	.596	164
8	203	841	381	"	1681	762	1100	499	4.17	106.	.379	167
9	229	1009	458	"	2236	1014	1500	680	3.81	96.8	.254	169
10	254	1207	547	"	2991	1357	2000	907	3.40	86.4	.170	169
11	279	1387	629	"	3694	1676	2500	1134	3.13	79.5	.125	171
12	305	1545	701	"	4383	1988	2900	1315	2.79	70.9	.0962	173
13	330	1704	773	"	5326	2416	3600	1633	2.60	66.0	.0723	173
4	102	379	172	*Eff*	408	185	280	127	9.04	230.	3.23	143
5	127	518	235	"	735	333	500	227	7.45	189.	1.49	144
6	152	721	327	"	1222	554	800	363	5.92	150.	.740	148
7	178	957	434	"	1872	849	1200	544	4.98	126.	.415	151
8	203	1122	509	"	2452	1112	1600	726	4.38	111.	.274	156
9	229	1290	585	"	3110	1411	2100	953	4.01	102.	.191	159
10	254	1477	670	"	3944	1789	2600	1179	3.48	88.4	.134	161
11	279	1663	754	"	4769	2163	3200	1451	3.18	80.8	.0994	164
12	305	1845	837	"	5672	2573	3800	1724	2.91	73.9	.0765	167
13	330	2036	924	"	6913	3136	4500	2041	2.58	65.5	.0574	166
4	102	398	181	*EEf*	427	194	280	127	8.65	220.	3.09	148
5	127	548	249	"	735	333	500	227	7.15	182.	1.43	148
6	152	763	346	"	1222	554	800	363	5.67	144.	.709	153
7	178	1024	464	"	1872	849	1200	544	4.74	120.	.395	157
8	203	1224	555	"	2452	1112	1600	726	4.16	106.	.260	163
9	229	1394	632	"	3110	1411	2100	953	3.84	97.5	.183	166
10	254	1580	717	"	3944	1789	2600	1179	3.35	85.1	.129	167
11	279	1762	799	"	4769	2163	3200	1451	3.09	78.5	.0966	169
12	305	1947	883	"	5672	2573	3800	1724	2.83	71.9	.0746	172
13	330	2147	974	"	6913	3136	4500	2041	2.51	63.8	.0558	170
4	102	411	186	*EEE*	427	194	280	127	8.60	218.	3.07	151
5	127	567	257	"	735	333	500	227	7.05	179.	1.41	153
6	152	792	359	"	1222	554	800	363	5.63	143.	.704	157
7	178	1066	484	"	1872	849	1200	544	4.70	119.	.392	161
8	203	1291	586	"	2452	1112	1600	726	4.14	105.	.259	167
9	229	1495	678	"	3110	1411	2100	953	3.82	97.0	.182	170
10	254	1684	764	"	3944	1789	2600	1179	3.33	84.6	.128	171
11	279	1866	846	"	4769	2163	3200	1451	3.08	78.2	.0962	172
12	305	2046	928	"	5672	2573	3800	1724	2.82	71.6	.0743	173
13	330	2248	1020	"	6913	3136	4500	2041	2.51	63.8	.0557	173

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—30 Feet (9.144 meters)

Sections: 21 feet, 7 feet and 5 feet (6.401 meters, 2.134 meters and 1.524 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
7697	4	102	309	140	*fff*	321	146	220	100	8.40	213.	3.82	162
7698	5	127	420	191	"	545	247	350	159	6.30	160.	1.80	164
7699	6	152	555	252	"	849	385	550	249	5.30	135.	.964	167
7700	7	178	700	318	"	1220	553	800	363	4.62	117.	.578	170
7701	8	203	860	390	"	1681	762	1100	499	4.07	103.	.370	172
7702	9	229	1030	467	"	2236	1014	1500	680	3.74	95.0	.249	173
7703	10	254	1231	558	"	2991	1357	2000	907	3.32	84.3	.166	173
7704	11	279	1411	640	"	3694	1676	2500	1134	3.08	78.2	.123	175
7705	12	305	1563	709	"	4383	1988	2900	1315	2.75	69.8	.0949	175
7706	13	330	1722	781	"	5326	2416	3600	1633	2.57	65.3	.0713	175
7707	4	102	397	180	*Eff*	427	194	280	127	8.29	211.	2.96	154
7708	5	127	544	247	"	735	333	500	227	6.85	174.	1.37	156
7709	6	152	757	343	"	1222	554	800	363	5.52	140.	.690	159
7710	7	178	1004	455	"	1872	849	1200	544	4.67	119.	.389	160
7711	8	203	1171	531	"	2452	1112	1600	726	4.16	106.	.260	164
7712	9	229	1340	608	"	3110	1411	2100	953	3.84	97.5	.183	166
7713	10	254	1529	694	"	3944	1789	2600	1179	3.33	84.6	.128	167
7714	11	279	1715	778	"	4769	2163	3200	1451	3.08	78.2	.0964	170
7715	12	305	1895	860	"	5672	2573	3800	1724	2.82	71.6	.0743	170
7716	13	330	2089	948	"	6913	3136	4500	2041	2.51	63.8	.0557	170
7717	4	102	416	189	*EEf*	427	194	280	127	8.09	205.	2.89	160
7718	5	127	573	260	"	735	333	500	227	6.70	170.	1.34	162
7719	6	152	798	362	"	1222	554	800	363	5.38	137.	.673	164
7720	7	178	1071	486	"	1872	849	1200	544	4.55	116.	.379	167
7721	8	203	1272	577	"	2452	1112	1600	726	4.05	103.	.253	171
7722	9	229	1444	655	"	3110	1411	2100	953	3.74	95.0	.178	173
7723	10	254	1633	741	"	3944	1789	2600	1179	3.28	83.3	.126	173
7724	11	279	1815	823	"	4769	2163	3200	1451	3.04	77.2	.0949	175
7725	12	305	1997	906	"	5672	2573	3800	1724	2.79	70.9	.0734	174
7726	13	330	2200	998	"	6913	3136	4500	2041	2.48	63.0	.0550	175
7727	4	102	425	193	*EEE*	427	194	280	127	8.06	205.	2.88	161
7728	5	127	587	266	"	735	333	500	227	6.70	170.	1.34	164
7729	6	152	819	371	"	1222	554	800	363	5.38	137.	.673	166
7730	7	178	1101	499	"	1872	849	1200	544	4.54	115.	.378	169
7731	8	203	1320	599	"	2452	1112	1600	726	4.05	103.	.253	173
7732	9	229	1517	688	"	3110	1411	2100	953	3.74	95.0	.178	174
7733	10	254	1707	774	"	3944	1789	2600	1179	3.28	83.3	.126	174
7734	11	279	1889	857	"	4769	2163	3200	1451	3.03	77.0	.0948	175
7735	12	305	2068	938	"	5672	2573	3800	1724	2.79	70.9	.0734	175
7736	13	330	2272	1031	"	6913	3136	4500	2041	2.48	63.0	.0550	175

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—31 Feet (9.449 meters)

Sections: 18 feet 6 inches, 10 feet 6 inches and 5 feet (5.638 meters, 3.200 meters and 1.524 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
37	4	102	308	140	*fff*	307	139	200	91	9.46	240.	4.73	163
38	5	127	421	191	"	522	237	350	159	7.70	196.	2.20	166
39	6	152	559	254	"	813	369	550	249	6.38	162.	1.16	170
40	7	178	707	321	"	1168	530	800	363	5.49	139.	.686	174
41	8	203	871	395	"	1609	730	1100	499	4.80	122.	.436	176
42	9	229	1045	474	"	2141	971	1400	635	4.09	104.	.292	178
43	10	254	1248	566	"	2864	1299	1900	862	3.72	94.5	.196	178
44	11	279	1438	652	"	3537	1604	2400	1089	3.43	87.1	.143	181
45	12	305	1599	725	"	4196	1903	2800	1270	3.08	78.2	.110	181
46	13	330	1759	798	"	5100	2313	3400	1542	2.82	71.6	.0829	180
47	4	102	386	175	*Eff*	352	160	220	100	8.38	213.	3.81	154
48	5	127	531	241	"	657	298	450	204	7.83	199.	1.74	157
49	6	152	736	334	"	1115	506	750	340	6.50	165.	.866	159
50	7	178	976	443	"	1738	788	1200	544	5.83	148.	.486	161
51	8	203	1145	519	"	2347	1065	1600	726	5.12	130.	.320	165
52	9	229	1319	598	"	2977	1350	2000	907	4.44	113.	.222	168
53	10	254	1511	685	"	3776	1713	2500	1134	3.88	98.5	.155	169
54	11	279	1707	774	"	4566	2071	3000	1361	3.45	87.6	.115	173
55	12	305	1891	858	"	5431	2463	3600	1633	3.18	80.8	.0884	174
56	13	330	2083	945	"	6618	3002	4500	2041	2.99	75.9	.0665	173
57	4	102	415	188	*EEf*	409	186	280	127	10.0	254.	3.58	161
58	5	127	575	261	"	704	319	450	204	7.38	187.	1.64	164
59	6	152	798	362	"	1170	531	800	363	6.51	165.	.814	167
60	7	178	1076	488	"	1792	813	1200	544	5.44	138.	.453	171
61	8	203	1297	588	"	2347	1065	1600	726	4.75	121.	.297	176
62	9	229	1474	669	"	2977	1350	2000	907	4.18	106.	.209	178
63	10	254	1666	756	"	3776	1713	2500	1134	3.68	93.5	.147	178
64	11	279	1856	842	"	4566	2071	3000	1361	3.30	83.8	.110	180
65	12	305	2044	927	"	5431	2463	3600	1633	3.07	78.0	.0852	181
66	13	330	2249	1020	"	6618	3002	4500	2041	2.88	73.2	.0640	180
7	4	102	424	192	*EEE*	409	186	280	127	10.0	254.	3.58	162
8	5	127	588	267	"	704	319	450	204	7.34	186.	1.63	166
9	6	152	819	371	"	1170	531	800	363	6.51	165.	.814	168
0	7	178	1106	502	"	1792	813	1200	544	5.42	138.	.452	172
1	8	203	1345	610	"	2347	1065	1600	726	4.75	121.	.297	177
2	9	229	1547	702	"	2977	1350	2000	907	4.18	106.	.209	179
3	10	254	1740	789	"	3776	1713	2500	1134	3.68	93.5	.147	179
4	11	279	1930	875	"	4566	2071	3000	1361	3.30	83.8	.110	181
5	12	305	2115	959	"	5431	2463	3600	1633	3.07	78.0	.0852	182
6	13	330	2321	1053	"	6618	3002	4500	2041	2.88	73.2	.0640	180

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—31 Feet (9.449 meters)

Sections: 21 feet, 6 feet 6 inches and 6 feet 6 inches (6.401 meters, 1.9
meters and 1.981 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m	
7777	4	102	314	142	*fff*	307	139	200	91	8.88	226.	4.44
7778	5	127	426	193	"	522	237	350	159	7.32	186.	2.09
7779	6	152	564	256	"	813	369	550	249	6.11	155.	1.11
7780	7	178	712	323	"	1168	530	800	363	5.33	135.	.666
7781	8	203	877	398	"	1609	730	1100	499	4.68	119.	.425
7782	9	229	1051	477	"	2141	971	1400	635	3.99	101.	.285
7783	10	254	1257	570	"	2864	1299	1900	862	3.63	92.2	.191
7784	11	279	1441	654	"	3537	1604	2400	1089	3.36	85.3	.140
7785	12	305	1601	726	"	4196	1903	2800	1270	3.05	77.5	.109
7786	13	330	1765	801	"	5100	2313	3400	1542	2.77	70.4	.0816
7787	4	102	402	182	*Eff*	409	186	280	127	9.69	246.	3.46
7788	5	127	550	249	"	704	319	450	204	7.25	184.	1.61
7789	6	152	766	347	"	1170	531	800	363	6.43	163.	.804
7790	7	178	1016	461	"	1792	813	1200	544	5.42	138.	.452
7791	8	203	1188	539	"	2347	1065	1600	726	4.82	122.	.301
7792	9	229	1361	617	"	2977	1350	2000	907	4.22	107.	.211
7793	10	254	1555	706	"	3776	1713	2500	1134	3.70	94.0	.148
7794	11	279	1746	792	"	4566	2071	3000	1361	3.33	84.6	.111
7795	12	305	1933	877	"	5431	2463	3600	1633	3.07	78.0	.0854
7796	13	330	2133	967	"	6618	3002	4500	2041	2.88	73.2	.0641
7797	4	102	420	191	*EEf*	409	186	280	127	9.41	239.	3.36
7798	5	127	577	262	"	704	319	450	204	7.02	178.	1.56
7799	6	152	804	365	"	1170	531	800	363	6.26	159.	.782
7800	7	178	1079	489	"	1792	813	1200	544	5.26	134.	.438
7801	8	203	1282	581	"	2347	1065	1600	726	4.66	118.	.291
7802	9	229	1458	661	"	2977	1350	2000	907	4.10	104.	.205
7803	10	254	1651	749	"	3776	1713	2500	1134	3.63	92.2	.145
7804	11	279	1838	834	"	4566	2071	3000	1361	3.27	83.1	.109
7805	12	305	2027	919	"	5431	2463	3600	1633	3.03	77.0	.0841
7806	13	330	2236	1014	"	6618	3002	4500	2041	2.83	71.9	.0629
7807	4	102	432	196	*EEE*	409	186	280	127	9.38	238.	3.35
7808	5	127	595	270	"	704	319	450	204	7.02	178.	1.56
7809	6	152	831	377	"	1170	531	800	363	6.22	158.	.778
7810	7	178	1117	507	"	1792	813	1200	544	5.24	133.	.437
7811	8	203	1344	610	"	2347	1065	1600	726	4.64	118.	.290
7812	9	229	1552	704	"	2977	1350	2000	907	4.08	104.	.204
7813	10	254	1747	792	"	3776	1713	2500	1134	3.60	91.4	.144
7814	11	279	1934	877	"	4566	2071	3000	1361	3.27	83.1	.109
7815	12	305	2120	962	"	5431	2463	3600	1633	3.02	76.7	.0840
7816	13	330	2330	1057	"	6618	3002	4500	2041	2.83	71.9	.0629

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—32 Feet (9.754 meters)

Sections: 18 feet 6 inches, 9 feet 6 inches and 7 feet (5.638 meters, 2.895 meters and 2.134 meters)

Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
4	102	312	142	*fff*	295	134	200	91	11.0	279.	5.50	165
5	127	426	193	"	500	227	350	159	8.93	227.	2.55	167
6	152	566	257	"	780	354	500	227	6.70	170.	1.34	173
7	178	718	326	"	1120	508	750	340	5.92	150.	.789	178
8	203	885	401	"	1544	700	1000	454	5.00	127.	.500	181
9	229	1063	482	"	2053	931	1400	635	4.68	119.	.334	182
10	254	1272	577	"	2747	1246	1800	816	4.03	102.	.224	183
11	279	1466	665	"	3392	1539	2300	1043	3.75	95.3	.163	186
12	305	1634	741	"	4025	1826	2700	1225	3.40	86.4	.126	188
13	330	1801	817	"	4891	2219	3300	1497	3.12	79.2	.0946	187
4	102	390	177	*Eff*	323	147	220	100	9.86	250.	4.48	155
5	127	535	243	"	602	273	400	181	8.16	207.	2.04	156
6	152	743	337	"	1022	464	700	318	7.07	180.	1.01	160
7	178	986	447	"	1593	723	1100	499	6.22	158.	.565	164
8	203	1159	526	"	2252	1022	1500	680	5.55	141.	.370	168
9	229	1337	606	"	2856	1295	1900	862	4.86	123.	.256	172
10	254	1534	696	"	3622	1643	2400	1089	4.30	109.	.179	174
11	279	1734	787	"	4380	1987	2900	1315	3.83	97.3	.132	178
12	305	1927	874	"	5209	2363	3500	1588	3.54	89.9	.101	181
13	330	2124	963	"	6348	2879	4200	1905	3.20	81.3	.0762	180
4	102	416	189	*EEf*	392	178	250	113	10.5	267.	4.19	160
5	127	575	261	"	675	306	450	204	8.60	218.	1.91	162
6	152	800	363	"	1122	509	750	340	7.10	180.	.946	167
7	178	1077	489	"	1719	780	1100	499	5.75	146.	.523	171
8	203	1297	588	"	2252	1022	1500	680	5.13	130.	.342	178
9	229	1478	670	"	2856	1295	1900	862	4.54	115.	.239	181
10	254	1675	760	"	3622	1643	2400	1089	4.06	103.	.169	181
11	279	1869	848	"	4380	1987	2900	1315	3.65	92.7	.126	184
12	305	2064	936	"	5209	2363	3500	1588	3.41	86.6	.0973	186
13	330	2274	1031	"	6348	2879	4200	1905	3.07	78.0	.0731	186
4	102	429	195	*EEE*	392	178	250	113	10.4	264.	4.17	164
5	127	594	269	"	675	306	450	204	8.55	217.	1.90	166
6	152	829	376	"	1122	509	750	340	7.06	179.	.941	170
7	178	1118	507	"	1719	780	1100	499	5.73	146.	.521	175
8	203	1364	619	"	2252	1022	1500	680	5.10	130.	.340	182
9	229	1579	716	"	2856	1295	1900	862	4.52	115.	.238	185
10	254	1779	807	"	3622	1643	2400	1089	4.03	102.	.168	185
11	279	1973	895	"	4380	1987	2900	1315	3.65	92.7	.126	187
12	305	2164	982	"	5209	2363	3500	1588	3.40	86.4	.0970	187
13	330	2376	1078	"	6348	2879	4200	1905	3.07	78.0	0730	188

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—32 Feet (9.754 meters)

Sections: 21 feet, 7 feet and 7 feet (6.401 meters, 2.134 meters and 2.134 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
7857	4	102	320	145	*fff*	295	134	200	91	10.2	259.	5.11	168
7858	5	127	435	197	"	500	227	350	159	8.44	214	2.41	170
7859	6	152	577	262	"	780	354	500	227	6.35	161.	1.27	175
7860	7	178	729	331	"	1120	508	750	340	5.71	145.	.761	180
7861	8	203	898	407	"	1544	700	1000	454	4.85	123.	.485	183
7862	9	229	1077	489	"	2053	931	1400	635	4.55	116.	.325	185
7863	10	254	1288	584	"	2747	1246	1800	816	3.92	99.6	.218	185
7864	11	279	1478	670	"	3392	1539	2300	1043	3.68	93.5	.160	187
7865	12	305	1644	746	"	4025	1826	2700	1225	3.35	85.1	.124	190
7866	13	330	1813	822	"	4891	2219	3300	1497	3.06	77.7	.0928	189
7867	4	102	409	186	*Eff*	392	178	250	113	10.1	257.	4.02	159
7868	5	127	559	254	"	675	306	450	204	8.37	213.	1.86	160
7869	6	152	778	353	"	1122	509	750	340	6.97	177.	.929	164
7870	7	178	1033	469	"	1719	780	1100	499	5.74	146.	.522	167
7871	8	203	1209	548	"	2252	1022	1500	680	5.19	132.	.346	172
7872	9	229	1387	629	"	2856	1295	1900	862	4.60	117.	.242	175
7873	10	254	1586	719	"	3622	1643	2400	1089	4.08	104	.170	177
7874	11	279	1783	809	"	4380	1987	2900	1315	3.68	93.5	.127	181
7875	12	305	1976	896	"	5209	2363	3500	1588	3.42	86.9	.0976	184
7876	13	330	2181	989	"	6348	2879	4200	1905	3.07	78.0	.0732	183
7877	4	102	428	194	*EEf*	392	178	250	113	9.70	246.	3.88	164
7878	5	127	589	267	"	675	306	450	204	8.10	206.	1.80	165
7879	6	152	820	372	"	1122	509	750	340	6.74	171.	.898	169
7880	7	178	1100	499	"	1719	780	1100	499	5.52	140.	.502	174
7881	8	203	1310	594	"	2252	1022	1500	680	5.00	127.	.333	179
7882	9	229	1491	676	"	2856	1295	1900	862	4.45	113.	.234	182
7883	10	254	1690	767	"	3622	1643	2400	1089	3.96	101.	.165	183
7884	11	279	1882	854	"	4380	1987	2900	1315	3.60	91.4	.124	185
7885	12	305	2078	943	"	5209	2363	3500	1588	3.35	85.1	.0957	188
7886	13	330	2291	1039	"	6348	2879	4200	1905	3.01	76.5	.0717	187
7887	4	102	441	200	*EEE*	392	178	250	113	9.65	245.	3.86	167
7888	5	127	608	276	"	675	306	450	204	8.06	205.	1.79	169
7889	6	152	849	385	"	1122	509	750	340	6.70	170.	.893	173
7890	7	178	1142	518	"	1719	780	1100	499	5.49	139.	.499	178
7891	8	203	1378	625	"	2252	1022	1500	680	4.97	126.	.331	184
7892	9	229	1593	723	"	2856	1295	1900	862	4.43	113.	.233	186
7893	10	254	1793	813	"	3622	1643	2400	1089	3.94	100.	.164	187
7894	11	279	1986	901	"	4380	1987	2900	1315	3.60	91.4	.124	188
7895	12	305	2177	987	"	5209	2363	3500	1588	3.34	84.8	.0955	189
7896	13	330	2393	1085	"	6348	2879	4200	1905	3.01	76.5	.0716	189

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—32 Feet (9.754 meters)

Sections: 21 feet, 10 feet and 4 feet (6.401 meters, 3.048 meters and 1.219 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
7897	4	102	326	148	*fff*	295	134	200	91	10.14	258.	5.07	175
7898	5	127	445	202	"	500	227	350	159	8.33	212.	2.38	178
7899	6	152	588	267	"	780	354	500	227	6.30	160.	1.26	182
7900	7	178	742	337	"	1120	508	750	340	5.67	144.	.756	185
7901	8	203	912	414	"	1544	700	1000	454	4.83	123.	.483	186
7902	9	229	1092	495	"	2053	931	1400	635	4.54	115.	.324	188
7903	10	254	1304	591	"	2747	1246	1800	816	3.91	99.3	.217	187
7904	11	279	1498	679	"	3392	1539	2300	1043	3.66	93.0	.159	190
7905	12	305	1660	753	"	4025	1826	2700	1225	3.32	84.3	.123	191
7906	13	330	1825	828	"	4891	2219	3300	1497	3.06	77.7	.0927	191
7907	4	102	414	188	*Eff*	392	178	250	113	9.95	253.	.98	166
7908	5	127	569	258	"	675	306	450	204	8.24	209.	83	169
7909	6	152	790	358	"	1122	509	750	340	6.89	175.	.918	171
7910	7	178	1046	474	"	1719	780	1100	499	5.69	145.	517	173
911	8	203	1222	554	"	2252	1022	1500	680	5.16	131.	.344	176
912	9	229	1403	636	"	2856	1295	1900	862	4.56	116.	.240	179
913	10	254	1602	727	"	3622	1643	2400	1089	4.06	103.	.169	180
914	11	279	1803	818	"	4380	1987	2900	1315	3.65	92.7	.126	184
915	12	305	1991	903	"	5209	2363	3500	1588	3.41	86.6	.0974	185
16	13	330	2193	995	"	6348	2879	4200	1905	3.07	78.0	.0731	185
17	4	102	441	200	*EEf*	392	178	250	113	9.58	243.	3.83	174
18	5	127	611	277	"	675	306	450	204	7.97	202.	1.77	177
19	6	152	849	385	"	1122	509	750	340	6.64	169.	.885	180
20	7	178	1142	518	"	1719	780	1100	499	5.46	139.	.496	183
21	8	203	1367	620	"	2252	1022	1500	680	4.95	126.	.330	187
22	9	229	1551	703	"	2856	1295	1900	862	4.41	112.	.232	188
23	10	254	1750	794	"	3622	1643	2400	1089	3.94	100.	.164	189
24	11	279	1945	882	"	4380	1987	2900	1315	3.57	90.7	.123	190
25	12	305	2136	969	"	5209	2363	3500	1588	3.34	84.8	.0953	191
26	13	330	2351	1066	"	6348	2879	4200	1905	3.00	76.2	.0715	191
27	4	102	449	204	*EEE*	392	178	250	113	9.58	243.	3.83	174
28	5	127	622	282	"	675	306	450	204	7.97	202.	1.77	178
29	6	152	866	393	"	1122	509	750	340	6.64	169.	.885	180
30	7	178	1166	529	"	1719	780	1100	499	5.46	139.	.496	183
31	8	203	1406	638	"	2252	1022	1500	680	4.95	126.	.330	188
32	9	229	1609	730	"	2856	1295	1900	862	4.41	112.	.232	189
33	10	254	1809	821	"	3622	1643	2400	1089	3.94	100.	.164	189
34	11	279	2004	909	"	4380	1987	2900	1315	3.57	90.7	.123	190
35	12	305	2193	995	"	5209	2363	3500	1588	3.34	84.8	.0953	191
36	13	330	2409	1093	"	6348	2879	4200	1905	3.00	76.2	.0715	191

"National" Wrought Steel Tubular Poles.—*Continued*

Length of Pole—33 Feet (10.059 meters)

Sections: 18 feet 6 inches, 10 feet 6 inches and 7 feet (5.638 meters, 3.2 meters and 2.134 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m	
7937	4	102	320	145	*fff*	283	128	190	86	12.0	305.	6.31
7938	5	127	437	198	"	481	218	300	136	8.73	222.	2.91
7939	6	152	580	263	"	749	240	500	227	7.60	193.	1.52
7940	7	178	737	334	"	1076	488	700	318	6.28	160.	.897
7941	8	203	909	412	"	1483	673	1000	454	5.68	144.	.568
7942	9	229	1092	495	"	1973	895	1300	590	4.93	125.	.379
7943	10	254	1306	592	"	2639	1197	1800	816	4.57	116.	.254
7944	11	279	1506	683	"	3259	1478	2200	998	4.07	103.	.185
7945	12	305	1680	762	"	3867	1754	2600	1179	3.69	93.7	.142
7946	13	330	1850	839	"	4699	2131	3100	1406	3.32	84.3	.107
7947	4	102	398	181	*Eff*	298	135	200	91	10.3	262.	5.17
7948	5	127	546	248	"	556	252	350	159	8.23	209.	2.35
7949	6	152	758	344	"	943	428	650	295	7.54	192.	1.16
7950	7	178	1005	456	"	1470	667	1000	454	6.49	165.	.649
7951	8	203	1183	537	"	2112	958	1400	635	5.94	151.	.424
7952	9	229	1366	620	"	2744	1245	1800	816	5.26	134.	.292
7953	10	254	1568	711	"	3480	1578	2300	1043	4.69	119.	.204
7954	11	279	1775	805	"	4208	1909	2800	1270	4.20	107.	.150
7955	12	305	1972	894	"	5005	2270	3300	1497	3.80	96.5	.115
7956	13	330	2174	986	"	6099	2766	4000	1814	3.47	88.1	.0868
7957	4	102	426	193	*EEf*	377	171	250	113	12.0	305.	4.80
7958	5	127	590	268	"	649	294	450	204	9.81	249.	2.18
7959	6	152	820	372	"	1078	489	700	318	7.56	192.	1.08
7960	7	178	1106	502	"	1652	749	1100	499	6.55	166.	.595
7961	8	203	1335	606	"	2163	981	1400	635	5.43	138.	.388
7962	9	229	1521	690	"	2744	1245	1800	816	4.88	124.	.271
7963	10	254	1724	782	"	3480	1578	2300	1043	4.39	112.	.191
7964	11	279	1924	873	"	4208	1909	2800	1270	4.00	102.	.143
7965	12	305	2125	964	"	5005	2270	3300	1497	3.63	92.2	.110
7966	13	330	2340	1061	"	6099	2766	4000	1814	3.31	84.1	.0828
7967	4	102	439	199	*EEE*	377	171	250	113	12.0	305.	4.78
7968	5	127	609	276	"	649	294	450	204	9.77	248.	2.17
7969	6	152	849	385	"	1078	489	700	318	7.49	190.	1.07
7970	7	178	1147	520	"	1652	749	1100	499	6.52	166.	.593
7971	8	203	1402	636	"	2163	981	1400	635	5.40	137.	.386
7972	9	229	1623	736	"	2744	1245	1800	816	4.86	123.	.270
7973	10	254	1827	829	"	3480	1578	2300	1043	4.39	112.	.191
7974	11	279	2027	919	"	4208	1909	2800	1270	4.00	102.	.143
7975	12	305	2224	1009	"	5005	2270	3300	1497	3.63	92.2	.110
7976	13	330	2441	1107	"	6099	2766	4000	1814	3.31	84.1	.0827

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—33 Feet (10.059 meters)

Sections: 21 feet, 10 feet and 5 feet (6.401 meters, 3.048 meters and 1.524 meters)

Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
4	102	332	151	*fff*	283	128	190	86	11.0	279.	5.80	179
5	127	453	205	"	481	218	300	136	8.16	207.	2.72	183
6	152	599	272	"	749	340	500	227	7.20	183.	1.44	187
7	178	757	343	"	1076	488	700	318	6.01	153.	.859	191
8	203	931	422	"	1483	673	1000	454	5.48	139.	.548	193
9	229	1115	506	"	1973	895	1300	590	4.77	121.	.367	194
10	254	1333	605	"	2639	1197	1800	816	4.43	113.	.246	194
11	279	1532	695	"	3259	1478	2200	998	3.98	101.	.181	197
12	305	1700	771	"	3867	1754	2600	1179	3.64	92.5	.140	198
13	330	1871	849	"	4699	2131	3100	1406	3.26	82.8	.105	198
4	102	420	191	*Eff*	369	167	250	113	11.5	292.	4.59	169
5	127	576	261	"	649	294	450	204	9.50	241.	2.11	173
6	152	801	363	"	1078	489	700	318	7.35	187.	1.05	175
7	178	1061	481	"	1652	749	1100	499	6.52	166.	.593	178
8	203	1241	563	"	2163	981	1400	635	5.52	140.	.394	182
9	229	1426	647	"	2744	1245	1800	816	4.93	125.	.274	184
10	254	1631	740	"	3480	1578	2300	1043	4.44	113.	.193	186
11	279	1837	833	"	4208	1909	2800	1270	4.03	102.	.144	190
12	305	2032	922	"	5005	2270	3300	1497	3.66	93.0	.111	191
13	330	2238	1015	"	6099	2766	4000	1814	3.32	84.3	.0830	191
4	102	447	203	*EEf*	377	171	250	113	11.00	279.	4.39	177
5	127	618	280	"	649	294	450	204	9.09	231.	2.02	181
6	152	860	390	"	1078	489	700	318	7.07	180.	1.01	184
7	178	1157	525	"	1652	749	1100	499	6.22	158.	.565	188
8	203	1386	629	"	2163	981	1400	635	5.24	133.	.374	193
9	229	1574	714	"	2744	1245	1800	816	4.73	120.	.263	194
10	254	1779	807	"	3480	1578	2300	1043	4.28	109.	.186	195
11	279	1979	898	"	4208	1909	2800	1270	3.92	99.6	.140	196
12	305	2177	987	"	5005	2270	3300	1497	3.56	90.4	.108	197
13	330	2396	1087	"	6099	2766	4000	1814	3.24	82.3	.0809	196
4	102	456	207	*EEE*	377	171	250	113	11.0	279.	4.38	178
5	127	632	287	"	649	294	450	204	9.09	231.	2.02	182
6	152	881	400	"	1078	489	700	318	7.07	180.	1.01	185
7	178	1187	538	"	1652	749	1100	499	6.20	157.	.564	189
8	203	1434	650	"	2163	981	1400	635	5.24	133.	.374	194
9	229	1647	747	"	2744	1245	1800	816	4.73	120.	.263	195
10	254	1853	841	"	3480	1578	2300	1043	4.28	109.	.186	196
11	279	2053	931	"	4208	1909	2800	1270	3.89	98.8	.139	197
12	305	2248	1020	"	5005	2270	3300	1497	3.56	90.4	.108	198
13	330	2469	1120	"	6099	2766	4000	1814	3.23	82.0	.0808	197

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—34 Feet (10.363 meters)

Sections: 19 feet 6 inches, 10 feet 6 inches and 7 feet (5.943 meters, 3.2
meters and 2.134 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Fa
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
8017	4	102	331	150	*fff*	273	124	180	82	12.5	318.	6.95	
8018	5	127	451	205	"	462	210	300	136	9.66	245.	3.22	
8019	6	152	599	272	"	721	327	500	227	8.45	215.	1.69	
8020	7	178	760	345	"	1036	470	700	318	6.98	177.	.997	
8021	8	203	938	425	"	1427	647	950	431	6.01	153.	.633	
8022	9	229	1126	511	"	1898	861	1300	590	5.49	139.	.422	
8023	10	254	1346	611	"	2539	1152	1700	771	4.81	122.	.283	
8024	11	279	1552	704	"	3136	1422	2100	953	4.33	110.	.206	
8025	12	305	1730	785	"	3721	1688	2500	1134	3.98	101.	.159	
8026	13	330	1905	864	"	4522	2051	3000	1361	3.60	91.4	.120	
8027	4	102	413	187	*Eff*	298	135	200	91	11.3	287.	5.66	
8028	5	127	566	257	"	556	252	350	159	9.03	229.	2.58	
8029	6	152	787	357	"	943	428	650	295	8.32	211.	1.28	
8030	7	178	1043	473	"	1470	667	1000	454	7.14	181.	.714	
8031	8	203	1226	556	"	2082	944	1400	635	6.57	167.	.469	
8032	9	229	1415	642	"	2640	1197	1800	816	5.83	148.	.324	
8033	10	254	1623	736	"	3348	1519	2200	998	4.97	126.	.226	
8034	11	279	1835	832	"	4049	1837	2700	1225	4.51	115.	.167	
8035	12	305	2038	924	"	4816	2184	3200	1451	4.10	104.	.128	
8036	13	330	2246	1019	"	5869	2662	3900	1769	3.76	95.5	.0965	
8037	4	102	441	200	*EEf*	362	164	250	113	13.2	335.	5.29	
8038	5	127	610	277	"	624	283	400	181	9.64	245.	2.41	
8039	6	152	849	385	"	1038	471	700	318	8.33	212.	1.19	
8040	7	178	1144	519	"	1589	721	1100	499	7.27	185.	.661	
8041	8	203	1378	625	"	2082	944	1400	635	6.05	154.	.432	
8042	9	229	1570	712	"	2640	1197	1800	816	5.44	138.	.302	
8043	10	254	1778	807	"	3348	1519	2200	998	4.69	119.	.213	
8044	11	279	1984	900	"	4049	1837	2700	1225	4.32	110.	.160	
8045	12	305	2190	993	"	4816	2184	3200	1451	3.94	100.	.123	
8046	13	330	2412	1094	"	5869	2662	3900	1769	3.60	91.4	.0924	
8047	4	102	454	206	*EEE*	362	164	250	113	13.2	335.	5.27	
8048	5	127	629	285	"	624	283	400	181	9.60	244.	2.40	
8049	6	152	878	398	"	1038	471	700	318	8.33	212.	1.19	
8050	7	178	1185	538	"	1589	721	1100	499	7.24	184.	.658	
8051	8	203	1446	656	"	2082	944	1400	635	6.02	153.	.430	
8052	9	229	1671	758	"	2640	1197	1800	816	5.42	138.	.301	
8053	10	254	1882	854	"	3348	1519	2200	998	4.69	119.	.213	
8054	11	279	2087	947	"	4049	1837	2700	1225	4.29	109.	.159	
8055	12	305	2289	1038	"	4816	2184	3200	1451	3.94	100.	.123	
8056	13	330	2513	1140	"	5869	2662	3900	1769	3.60	91.4	.0923	

"National" Wrought Steel Tubular Poles.—*Continued*

Length of Pole—34 Feet (10.363 meters)

Sections: 21 feet, 9 feet 6 inches and 6 feet 6 inches (6.401 meters, 2.895 meters and 1.981 meters)

Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
4	102	336	152	*fff*	273	124	180	82	12.0	305.	.664	182
5	127	459	208	"	462	210	300	136	9.30	236.	3.10	185
6	152	608	276	"	721	327	500	227	8.20	208.	1.64	190
7	178	769	349	"	1036	470	700	318	6.82	173.	.974	195
8	203	947	430	"	1427	647	950	431	5.89	150.	.620	198
9	229	1136	515	"	1898	861	1300	590	5.40	137.	.415	200
10	254	1359	616	"	2539	1152	1700	771	4.73	120.	.278	200
11	279	1563	709	"	3136	1422	2100	953	4.28	109.	.204	202
12	305	1738	788	"	3721	1688	2500	1134	3.93	99.8	.157	205
13	330	1914	868	"	4522	2051	3000	1361	3.54	89.9	.118	204
4	102	425	193	*Eff*	337	153	220	100	11.6	295.	5.29	172
5	127	582	264	"	624	283	400	181	9.72	247.	2.43	174
6	152	810	367	"	1038	471	700	318	8.47	215.	1.21	178
7	178	1073	487	"	1589	721	1100	499	7.47	190.	.679	181
8	203	1258	571	"	2082	944	1400	635	6.29	160.	.449	186
9	229	1447	656	"	2640	1197	1800	816	5.62	143.	.312	189
10	254	1657	752	"	3348	1519	2200	998	4.82	122.	.219	191
11	279	1867	847	"	4049	1837	2700	1225	4.40	112.	.163	195
12	305	2070	939	"	4816	2184	3200	1451	4.00	102.	.125	197
13	330	2282	1035	"	5869	2662	3900	1769	3.67	93.2	.0940	196
4	102	451	205	*EEf*	362	164	250	113	12.6	320.	5.03	178
5	127	622	282	"	624	283	400	181	9.24	235.	2.31	181
6	152	866	393	"	1038	471	700	318	8.05	204.	1.15	185
7	178	1165	528	"	1589	721	1100	499	7.06	179.	.642	190
8	203	1396	633	"	2082	944	1400	635	5.94	151.	.424	196
9	229	1588	720	"	2640	1197	1800	816	5.36	136.	.298	198
10	254	1797	815	"	3348	1519	2200	998	4.62	117.	.210	199
11	279	2002	908	"	4049	1837	2700	1225	4.27	108.	.158	201
12	305	2208	1001	"	4816	2184	3200	1451	3.90	99.1	.122	203
13	330	2432	1103	"	5869	2662	3900	1769	3.56	90.4	.0913	203
4	102	463	210	*EEE*	362	164	250	113	12.6	320.	5.02	181
5	127	640	290	"	624	283	400	181	9.20	234.	2.30	184
6	152	893	405	"	1038	471	700	318	8.05	204.	1.15	188
7	178	1203	546	"	1589	721	1100	499	7.05	179.	.641	193
8	203	1458	661	"	2082	944	1400	635	5.92	150.	.423	199
9	229	1682	763	"	2640	1197	1800	816	5.35	136.	.297	202
10	254	1894	859	"	3348	1519	2200	998	4.60	117.	.209	202
11	279	2098	952	"	4049	1837	2700	1225	4.24	108.	.157	204
12	305	2300	1043	"	4816	2184	3200	1451	3.90	99.1	.122	205
13	330	2526	1146	"	5869	2662	3900	1769	3.56	90.4	.0912	204

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—35 Feet (10.668 meters)

Sections: 18 feet 6 inches, 10 feet and 9 feet 6 inches (5.638 meters, 3.048 meters and 2.895 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
8097	4	102	331	150	*fff*	258	117	170	77	14.2	361	8.33	179
8098	5	127	450	204	"	446	202	300	136	11.5	292	3.84	180
8099	6	152	600	272	"	695	315	450	204	8.91	226	1.98	187
8100	7	178	764	347	"	998	453	650	295	7.54	192	1.16	194
8101	8	203	945	429	"	1375	624	900	408	6.57	167	.730	199
8102	9	229	1137	516	"	1829	830	1200	544	5.82	148	.485	201
8103	10	254	1360	617	"	2447	1110	1600	726	5.20	132	.325	202
8104	11	279	1571	713	"	3022	1371	2000	907	4.70	119	.235	205
8105	12	305	1758	797	"	3586	1627	2400	1089	4.34	110	.181	209
8106	13	330	1939	879	"	4358	1977	2900	1315	3.94	100	.136	208
8107	4	102	408	185	*Eff*	258	117	170	77	11.8	300	6.96	168
8108	5	127	559	254	"	482	219	300	136	9.48	241	3.16	168
8109	6	152	778	353	"	817	371	550	249	8.53	217	1.55	174
8110	7	178	1032	468	"	1274	578	850	386	7.29	185	.858	178
8111	8	203	1218	552	"	1830	830	1200	544	6.67	169	.556	185
8112	9	229	1410	640	"	2522	1144	1700	771	6.46	164	.380	189
8113	10	254	1623	736	"	3227	1464	2200	998	5.83	148	.265	192
8114	11	279	1839	834	"	3902	1770	2600	1179	5.04	128	.194	197
8115	12	305	2051	930	"	4641	2105	3100	1406	4.59	117	.148	200
8116	13	330	2263	1026	"	5656	2565	3800	1724	4.26	108	.112	199
8117	4	102	436	198	*EEf*	335	152	220	100	14.1	358	6.42	172
8118	5	127	601	273	"	597	271	400	181	11.7	297	2.92	172
8119	6	152	837	380	"	1000	454	650	295	9.30	236	1.43	178
8120	7	178	1128	512	"	1532	695	1000	454	7.81	198	.781	184
8121	8	203	1363	618	"	2006	910	1300	590	6.53	166	.502	192
8122	9	229	1558	707	"	2544	1154	1700	771	5.93	151	.349	196
8123	10	254	1771	803	"	3227	1464	2200	998	5.41	137	.246	198
8124	11	279	1981	899	"	3902	1770	2600	1179	4.76	121	.183	202
8125	12	305	2196	996	"	4641	2105	3100	1406	4.37	111	.141	204
8126	13	330	2421	1098	"	5656	2565	3800	1724	4.03	102	.106	204
8127	4	102	453	205	*EEE*	335	152	220	100	13.9	353	6.33	177
8128	5	127	627	284	"	601	273	400	181	11.5	292	2.87	179
8129	6	152	877	398	"	1000	454	650	295	9.17	233	1.41	185
8130	7	178	1184	537	"	1532	695	1000	454	7.70	196	.770	191
8131	8	203	1455	660	"	2006	910	1300	590	6.44	164	.495	199
8132	9	229	1696	769	"	2544	1154	1700	771	5.87	149	.345	204
8133	10	254	1911	867	"	3227	1464	2200	998	5.35	136	.243	205
8134	11	279	2122	963	"	3902	1770	2600	1179	4.71	120	.181	208
8135	12	305	2331	1057	"	4641	2105	3100	1406	4.34	110	.140	208
8136	13	330	2559	1161	"	5656	2565	3800	1724	3.99	101	.105	208

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—35 Feet (10.668 meters)

ctions: 21 feet, 10 feet and 7 feet (6.401 meters, 3.048 meters and 2.134 meters)

Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
4	102	343	156	*fff*	263	119	180	82	13.6	345	7.54	187
5	127	468	212	"	446	202	300	136	10.5	267	3.51	190
6	152	621	282	"	695	315	450	204	8.33	212	1.85	196
7	178	786	357	"	998	453	650	295	7.15	182	1.10	201
8	203	969	440	"	1375	624	900	408	6.28	160	.698	204
9	229	1162	527	"	1829	830	1200	544	5.60	142	.467	206
10	254	1390	630	"	2447	1110	1600	726	5.00	127	.313	206
11	279	1600	726	"	3022	1371	2000	907	4.58	116	.229	210
12	305	1781	808	"	3586	1627	2400	1089	4.25	108	.177	213
13	330	1962	890	"	4358	1977	2900	1315	3.86	98	.133	211
4	102	431	195	*Eff*	310	141	200	91	12.1	307	6.06	176
5	127	592	269	"	578	262	400	181	11.1	282	2.77	178
6	152	822	373	"	981	445	650	295	8.97	228	1.38	182
7	178	1090	494	"	1529	694	1000	454	7.73	196	.773	186
8	203	1279	580	"	2006	910	1300	590	6.63	168	.510	191
9	229	1473	668	"	2544	1154	1700	771	6.00	152	.353	195
10	254	1688	766	"	3227	1464	2200	998	5.43	138	.247	197
11	279	1904	864	"	3902	1770	2600	1179	4.76	121	.183	201
12	305	2113	958	"	4641	2105	3100	1406	4.37	111	.141	204
13	330	2329	1056	"	5656	2565	3800	1724	4.03	102	.106	203
4	102	459	208	*EEf*	349	158	220	100	12.6	320	5.73	183
5	127	634	288	"	601	273	400	181	10.5	267	2.62	185
6	152	881	400	"	1000	454	650	295	8.52	216	1.31	190
7	178	1186	538	"	1532	695	1000	454	7.26	184	.726	195
8	203	1424	646	"	2006	910	1300	590	6.20	157	.477	202
9	229	1621	735	"	2544	1154	1700	771	5.70	145	.335	204
10	254	1836	833	"	3227	1464	2200	998	5.19	132	.236	205
11	279	2046	928	"	3902	1770	2600	1179	4.60	117	.177	208
12	305	2258	1024	"	4641	2105	3100	1406	4.25	108	.137	211
13	330	2487	1128	"	5656	2565	3800	1724	3.91	993	.103	209
4	102	472	214	*EEE*	349	158	220	100	12.6	320	5.71	186
5	127	653	296	"	601	273	400	181	10.4	264	2.61	189
6	152	911	413	"	1000	454	650	295	8.45	215	1.30	194
7	178	1228	557	"	1532	695	1000	454	7.23	184	.723	198
8	203	1492	677	"	2006	910	1300	590	6.18	157	.475	205
9	229	1723	782	"	2544	1154	1700	771	5.66	144	.333	208
10	254	1940	880	"	3227	1464	2200	998	5.17	131	.235	209
11	279	2150	975	"	3902	1770	2600	1179	4.60	117	.177	211
12	305	2357	1069	"	4641	2105	3100	1406	4.22	107	.136	212
13	330	2589	1174	"	5656	2565	3800	1724	3.88	985	.102	211

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—35 Feet (10.668 meters)

Sections: 18 feet 6 inches, 9 feet 6 inches, 6 feet 6 inches and 5 feet (5.638 meters, 2.895 meters, 1.981 meters and 1.524 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
8177	5	127	451	205	*ffff*	446	202	300	136	11.6	295	3.88	175
8178	6	152	598	271	"	695	315	450	204	9.00	229	2.00	183
8179	7	178	764	347	"	998	453	650	295	7.54	192	1.16	191
8180	8	203	949	430	"	1375	624	900	408	6.60	168	.733	196
8181	9	229	1147	520	"	1829	830	1200	544	5.84	148	.487	199
8182	10	254	1375	624	"	2447	1110	1600	726	5.22	133	.326	200
8183	11	279	1592	722	"	3022	1371	2000	907	4.72	120	.236	204
8184	12	305	1784	809	"	3586	1627	2400	1089	4.34	110	.181	208
8185	13	330	1980	898	"	4358	1977	2900	1315	3.94	100	.136	207
8186	5	127	560	254	*Efff*	482	219	300	136	9.60	244	3.20	164
8187	6	152	776	352	"	817	371	550	249	8.64	219	1.57	168
8188	7	178	1032	468	"	1274	578	850	386	7.34	186	.864	174
8189	8	203	1223	555	"	1830	830	1200	544	6.71	170	.559	182
8190	9	229	1421	645	"	2522	1144	1700	771	6.49	165	.382	187
8191	10	254	1638	743	"	3227	1464	2200	998	5.83	148	.265	190
8192	11	279	1860	844	"	3902	1770	2600	1179	5.04	128	.194	195
8193	12	305	2076	942	"	4641	2105	3100	1406	4.59	117	.148	198
8194	13	330	2304	1045	"	5656	2565	3900	1769	4.37	111	.112	198
8195	5	127	600	272	*EEff*	554	251	350	159	10.4	264	2.96	166
8196	6	152	832	377	"	1000	454	650	295	9.43	240	1.45	172
8197	7	178	1124	510	"	1532	695	1000	454	7.89	200	.789	179
8198	8	203	1360	617	"	2006	910	1300	590	6.58	167	.506	188
8199	9	229	1561	708	"	2544	1154	1700	771	5.98	152	.352	193
8200	10	254	1778	807	"	3227	1464	2200	998	5.43	138	.247	195
8201	11	279	1995	905	"	3902	1770	2600	1179	4.78	121	.184	200
8202	12	305	2214	1004	"	4641	2105	3100	1406	4.37	111	.141	203
8203	13	330	2454	1113	"	5656	2565	3900	1769	4.13	105	.106	203
8204	5	127	618	280	*EEEf*	601	273	400	181	11.6	295	2.90	172
8205	6	152	859	390	"	1000	454	650	295	9.23	234	1.42	178
8206	7	178	1162	527	"	1532	695	1000	454	7.75	197	.775	185
8207	8	203	1423	645	"	2006	910	1300	590	6.47	164	.498	195
8208	9	229	1655	751	"	2544	1154	1700	771	5.88	149	.346	201
8209	10	254	1874	850	"	3227	1464	2200	998	5.37	136	.244	202
8210	11	279	2091	948	"	3902	1770	2600	1179	4.73	120	.182	205
8211	12	305	2306	1046	"	4641	2105	3100	1406	4.34	110	.140	207
8212	13	330	2548	1156	"	5656	2565	3900	1769	4.10	104	.105	206
8213	5	127	627	284	*EEEE*	601	273	400	181	11.6	295	2.90	174
8214	6	152	873	396	"	1000	454	650	295	9.23	234	1.42	180
8215	7	178	1183	537	"	1532	695	1000	454	7.75	197	.775	187
8216	8	203	1452	659	"	2006	910	1300	590	6.46	164	.497	196
8217	9	229	1703	772	"	2544	1154	1700	771	5.88	149	.346	202
8218	10	254	1947	883	"	3227	1464	2200	998	5.37	136	.244	203
8219	11	279	2165	982	"	3902	1770	2600	1179	4.73	120	.182	206
8220	12	305	2380	1080	"	4641	2105	3100	1406	4.34	110	.140	207
8221	13	330	2619	1188	"	5656	2565	3900	1769	4.10	104	.105	207

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—36 Feet (10.973 meters)

Sections: 18 feet 6 inches, 10 feet 6 inches and 10 feet (5.638 meters, 3.200 meters and 3.048 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
8222	4	102	337	153	*fff*	242	110	160	73	15.1	384	9.45	185
8223	5	127	459	208	"	430	195	280	127	12.2	310	4.35	185
8224	6	152	613	278	"	670	304	450	204	10.1	257	2.24	193
8225	7	178	780	354	"	963	437	650	295	8.45	215	1.30	201
8226	8	203	966	438	"	1327	602	900	408	7.38	187	.820	205
8227	9	229	1162	527	"	1765	801	1200	544	6.53	166	.544	208
8228	10	254	1391	631	"	2361	1071	1600	726	5.82	148	.364	209
8229	11	279	1608	729	"	2916	1323	1900	862	5.00	127	.263	212
8230	12	305	1801	817	"	3460	1569	2300	1043	4.65	118	.202	216
8231	13	330	1987	901	"	4205	1907	2800	1270	4.26	108	.152	215
8232	4	102	415	188	*Eff*	242	110	160	73	12.7	323	7.95	174
8233	5	127	568	258	"	452	205	300	136	10.8	274	3.60	174
8234	6	152	790	358	"	766	347	500	227	8.85	225	1.77	179
8235	7	178	1049	476	"	1195	542	800	363	7.79	198	.974	184
8236	8	203	1240	562	"	1716	778	1100	499	6.92	176	.629	191
8237	9	229	1436	651	"	2364	1072	1600	726	6.88	175	.430	196
8238	10	254	1654	750	"	3113	1412	2100	953	6.26	159	.298	198
8239	11	279	1876	851	"	3765	1708	2500	1134	5.45	138	.218	203
8240	12	305	2094	950	"	4478	2031	3000	1361	4.98	126	.166	206
8241	13	330	2311	1048	"	5457	2475	3600	1633	4.50	114	.125	205
8242	4	102	444	201	*EEf*	314	142	200	91	14.6	371	7.29	177
8243	5	127	613	278	"	554	251	350	159	11.6	295	3.31	177
8244	6	152	852	386	"	965	438	650	295	10.5	267	1.62	183
8245	7	178	1149	521	"	1478	670	1000	454	8.81	224	.881	190
8246	8	203	1392	631	"	1935	878	1300	590	7.33	186	.564	198
8247	9	229	1592	722	"	2455	1114	1600	726	6.27	159	.392	202
8248	10	254	1809	821	"	3113	1412	2100	953	5.80	147	.276	205
8249	11	279	2025	918	"	3765	1708	2500	1134	5.13	130	.205	208
8250	12	305	2246	1019	"	4478	2031	3000	1361	4.71	120	.157	212
8251	13	330	2477	1124	"	5457	2475	3600	1633	4.25	108	.118	210
8252	4	102	462	210	*EEE*	314	142	200	91	14.4	366	7.19	183
8253	5	127	640	290	"	580	263	400	181	13.0	330	3.25	184
8254	6	152	894	406	"	965	438	650	295	10.3	262	1.59	191
8255	7	178	1208	548	"	1478	670	1000	454	8.67	220	.867	197
8256	8	203	1488	675	"	1935	878	1300	590	7.23	184	.556	206
8257	9	229	1737	788	"	2455	1114	1600	726	6.18	157	.386	211
8258	10	254	1957	888	"	3113	1412	2100	953	5.73	146	.273	212
8259	11	279	2173	986	"	3765	1708	2500	1134	5.08	129	.203	214
8260	12	305	2388	1083	"	4478	2031	3000	1361	4.68	119	.156	216
8261	13	330	2622	1189	"	5457	2475	3600	1633	4.25	108	.118	214

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—36 Feet (10.973 meters)

Sections: 19 feet, 9 feet 6 inches, 7 feet and 5 feet (5.791 meters, 2.895 meters, 2.134 meters and 1.524 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load P		Load for Deflection *D* L		Deflection for Load *L* D		Factor *R*	Factor *m*
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
8262	5	127	462	210	*ffff*	430	195	280	127	12.1	307	4.33	181
8263	6	152	613	278	"	670	304	450	204	10.0	254	2.23	189
8264	7	178	783	355	"	963	437	650	295	8.45	215	1.30	197
8265	8	203	973	441	"	1327	602	900	408	7.34	186	.816	203
8266	9	229	1175	533	"	1765	801	1200	544	6.50	165	.542	206
8267	10	254	1409	639	"	2361	1071	1600	726	5.81	148	.363	207
8268	11	279	1631	740	"	2916	1323	1900	862	5.00	127	.263	211
8269	12	305	1829	830	"	3460	1569	2300	1043	4.65	118	.202	215
8270	13	330	2030	921	"	4205	1907	2800	1270	4.26	108	.152	214
8271	5	127	574	260	*Efff*	466	211	300	136	10.7	272	3.57	169
8272	6	152	796	361	"	791	359	550	249	9.63	245	1.75	174
8273	7	178	1059	480	"	1233	559	800	363	7.70	196	.963	180
8274	8	203	1254	569	"	1771	803	1200	544	7.46	189	.622	188
8275	9	229	1457	661	"	2440	1107	1600	726	6.80	173	.425	194
8276	10	254	1679	762	"	3113	1412	2100	953	6.20	157	.295	197
8277	11	279	1907	865	"	3765	1708	2500	1134	5.40	137	.216	201
8278	12	305	2129	966	"	4478	2031	3000	1361	4.95	126	.165	206
8279	13	330	2363	1072	"	5457	2475	3600	1633	4.46	113	.124	204
8280	5	127	614	279	*EEff*	517	235	350	159	11.6	295	3.31	171
8281	6	152	852	386	"	964	437	650	295	10.5	267	1.62	177
8282	7	178	1150	522	"	1478	670	1000	454	8.80	224	.880	185
8283	8	203	1392	631	"	1935	878	1300	590	7.35	187	.565	194
8284	9	229	1597	724	"	2455	1114	1600	726	6.27	159	.392	199
8285	10	254	1820	826	"	3113	1412	2100	953	5.80	147	.276	202
8286	11	279	2042	926	"	3765	1708	2500	1134	5.13	130	.205	206
8287	12	305	2267	1028	"	4478	2031	3000	1361	4.71	120	.157	210
8288	13	330	2513	1140	"	5457	2475	3600	1633	4.25	108	.118	209
8289	5	127	633	287	*EEEf*	580	263	400	181	13.0	330	3.24	178
8290	6	152	881	400	"	965	438	650	295	10.3	262	1.58	184
8291	7	178	1191	540	"	1478	670	1000	454	8.64	219	.864	192
8292	8	203	1459	662	"	1935	878	1300	590	7.22	183	.555	202
8293	9	229	1699	771	"	2455	1114	1600	726	6.16	156	.385	208
8294	10	254	1923	872	"	3113	1412	2100	953	5.69	145	.271	209
8295	11	279	2146	973	"	3765	1708	2500	1134	5.05	128	.202	212
8296	12	305	2366	1073	"	4478	2031	3000	1361	4.68	119	.156	214
8297	13	330	2614	1186	"	5457	2475	3600	1633	4.21	107	.117	213
8298	5	127	642	291	*EEEE*	580	263	400	181	12.9	328	3.23	180
8299	6	152	895	406	"	965	438	650	295	10.3	262	1.58	186
8300	7	178	1212	550	"	1478	670	1000	454	8.64	219	.864	193
8301	8	203	1488	675	"	1935	878	1300	590	7.20	183	.554	203
8302	9	229	1747	792	"	2455	1114	1600	726	6.16	156	.385	209
8303	10	254	1996	905	"	3113	1412	2100	953	5.69	145	.271	210
8304	11	279	2220	1007	"	3765	1708	2500	1134	5.05	128	.202	213
8305	12	305	2440	1107	"	4478	2031	3000	1361	4.68	119	.156	215
8306	13	330	2685	1218	"	5457	2475	3600	1633	4.21	107	.117	214

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—37 Feet (11.278 meters)

Sections: 19 feet, 10 feet 6 inches and 10 feet 6 inches (5.791 meters, 3.200 meters and 3.200 meters)

Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
4	102	346	157	*fff*	235	107	160	73	16.8	427	10.5	191
5	127	470	213	"	415	188	280	127	13.6	345	4.84	191
6	152	628	285	"	648	294	450	204	11.2	284	2.49	200
7	178	799	362	"	930	422	600	272	8.70	221	1.45	207
8	203	990	449	"	1282	581	850	386	7.73	196	.909	212
9	229	1191	540	"	1705	773	1100	499	6.64	169	.604	215
10	254	1426	647	"	2281	1035	1500	680	6.06	154	.404	216
11	279	1648	748	"	2817	1278	1900	862	5.55	141	.292	219
12	305	1846	837	"	3343	1516	2200	998	4.93	125	.224	223
13	330	2037	924	"	4062	1842	2700	1225	4.56	116	.169	222
4	102	425	193	*Eff*	235	107	160	73	14.1	358	8.82	180
5	127	582	264	"	438	199	300	136	12.0	305	4.00	179
6	152	810	367	"	743	337	500	227	9.80	249	1.96	185
7	178	1075	488	"	1158	525	750	340	8.10	206	1.08	190
8	203	1271	577	"	1664	755	1100	499	7.68	195	.698	197
9	229	1472	668	"	2292	1040	1500	680	7.14	181	.476	202
10	254	1696	769	"	3008	1364	2000	907	6.62	168	.331	205
11	279	1923	872	"	3637	1650	2400	1089	5.81	148	.242	209
12	305	2147	974	"	4326	1962	2900	1315	5.34	136	.184	213
13	330	2370	1075	"	5272	2391	3500	1588	4.87	124	.139	213
4	102	454	206	*EEf*	305	138	200	91	16.2	411	8.11	183
5	127	627	284	"	517	235	350	159	12.9	328	3.68	182
6	152	872	396	"	932	423	600	272	10.8	274	1.80	189
7	178	1176	533	"	1428	648	950	431	9.30	236	.979	195
8	203	1423	645	"	1870	848	1200	544	7.54	192	.628	204
9	229	1628	738	"	2372	1076	1600	726	6.98	177	.436	209
10	254	1851	840	"	3008	1364	2000	907	6.12	155	.306	211
11	279	2072	940	"	3637	1650	2400	1089	5.47	139	.228	215
12	305	2299	1043	"	4326	1962	2900	1315	5.08	129	.175	218
13	330	2535	1150	"	5272	2391	3500	1588	4.59	117	.131	218
4	102	474	215	*EEE*	305	138	200	91	16.0	406	7.98	189
5	127	655	297	"	560	254	350	159	12.6	320	3.61	190
6	152	916	415	"	932	423	600	272	10.6	269	1.76	197
7	178	1238	562	"	1428	648	950	431	9.15	232	.963	203
8	203	1524	691	"	1870	848	1200	544	7.40	188	.617	213
9	229	1780	807	"	2372	1076	1600	726	6.86	174	.429	218
10	254	2006	910	"	3008	1364	2000	907	6.04	153	.302	219
11	279	2228	1011	"	3637	1650	2400	1089	5.40	137	.225	221
12	305	2448	1110	"	4326	1962	2900	1315	5.02	128	.173	223
13	330	2688	1219	"	5272	2391	3500	1588	4.55	116	.130	223

"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—38 Feet (11.582 meters)

Sections: 20 feet, 10 feet 6 inches and 10 feet 6 inches (6.096 meters
3.200 meters and 3.200 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load P		Load for Deflection D L		Deflection for Load L D		Factor R
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m	
8347	4	102	356	161	*fff*	235	107	160	73	18.2	462	11.4
8348	5	127	485	220	"	402	182	280	127	14.7	373	5.25
8349	6	152	647	293	"	626	284	400	181	10.8	274	2.71
8350	7	178	823	373	"	900	408	600	272	9.48	241	1.58
8351	8	203	1018	462	"	1240	562	850	386	8.46	215	.995
8352	9	229	1225	556	"	1649	748	1100	499	7.28	185	.662
8353	10	254	1466	665	"	2206	1001	1500	680	6.65	169	.443
8354	11	279	1693	768	"	2725	1236	1800	816	5.78	147	.321
8355	12	305	1896	860	"	3233	1466	2200	998	5.41	137	.246
8356	13	330	2092	949	"	3929	1782	2600	1179	4.84	123	.186
8357	4	102	440	200	*Eff*	235	107	160	73	15.2	386	9.47
8358	5	127	603	274	"	438	199	300	136	12.9	328	4.31
8359	6	152	839	381	"	743	337	500	227	10.6	269	2.11
8360	7	178	1113	505	"	1158	525	750	340	8.78	223	1.17
8361	8	203	1314	596	"	1664	755	1100	499	8.33	212	.757
8362	9	229	1521	690	"	2292	1040	1500	680	7.77	197	.518
8363	10	254	1750	794	"	2909	1319	1900	862	6.84	174	.360
8364	11	279	1983	899	"	3518	1596	2300	1043	6.07	154	.264
8365	12	305	2212	1003	"	4184	1898	2800	1270	5.66	144	.202
8366	13	330	2442	1108	"	5099	2313	3400	1542	5.17	131	.152
8367	4	102	469	213	*EEf*	305	138	200	91	17.5	445	8.76
8368	5	127	647	293	"	517	235	350	159	14.0	356	3.99
8369	6	152	901	409	"	902	409	600	272	11.7	297	1.95
8370	7	178	1214	551	"	1381	626	900	408	9.63	245	1.07
8371	8	203	1467	665	"	1808	820	1200	544	8.23	209	.686
8372	9	229	1676	760	"	2294	1040	1500	680	7.16	182	.477
8373	10	254	1906	865	"	2909	1319	1900	862	6.38	162	.336
8374	11	279	2132	967	"	3518	1596	2300	1043	5.75	146	.250
8375	12	305	2364	1072	"	4184	1898	2800	1270	5.38	137	.192
8376	13	330	2608	1183	"	5099	2313	3400	1542	4.90	124	.144
8377	4	102	489	222	*EEE*	305	138	200	91	17.3	439	8.63
8378	5	127	676	307	"	542	246	350	159	13.7	348	3.91
8379	6	152	945	429	"	902	409	600	272	11.5	292	1.92
8380	7	178	1276	579	"	1381	626	900	408	9.45	240	1.05
8381	8	203	1567	711	"	1808	820	1200	544	8.11	206	.676
8382	9	229	1829	830	"	2294	1040	1500	680	7.05	179	.470
8383	10	254	2061	935	"	2909	1319	1900	862	6.29	160	.331
8384	11	279	2288	1038	"	3518	1596	2300	1043	5.68	144	.247
8385	12	305	2514	1140	"	4184	1898	2800	1270	5.32	135	.190
8386	13	330	2760	1252	"	5099	2313	3400	1542	4.86	123	.143

"National" Wrought Steel Tubular Poles.—*Continued*

Length of Pole—39 Feet (11.887 meters)

Sections: 21 feet, 10 feet 6 inches and 10 feet 6 inches (6.401 meters, 3.200 meters and 3.200 meters)

Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Factor *m*
Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
4	102	367	166	*fff*	229	104	150	68	18.5	470	12.3	205
5	127	500	227	"	389	176	250	113	14.2	361	5.69	206
6	152	666	302	"	607	275	400	181	11.8	300	2.94	215
7	178	846	384	"	871	395	600	272	10.3	262	1.72	223
8	203	1047	475	"	1201	545	800	363	8.72	221	1.09	228
9	229	1259	571	"	1597	724	1100	499	7.95	202	.723	231
10	254	1507	684	"	2136	969	1400	635	6.78	172	.484	232
11	279	1739	789	"	2638	1197	1800	816	6.34	161	.352	235
12	305	1946	883	"	3130	1420	2100	953	5.67	144	.270	239
13	330	2146	973	"	3804	1725	2500	1134	5.08	129	.203	238
4	102	455	206	*Eff*	235	107	160	73	16.3	414	10.2	193
5	127	623	283	"	438	199	300	136	13.9	353	4.63	192
6	152	867	393	"	743	337	500	227	11.4	290	2.28	199
7	178	1151	522	"	1158	525	750	340	9.45	240	1.26	204
8	203	1358	616	"	1664	755	1100	499	9.02	229	.820	212
9	229	1570	712	"	2221	1007	1500	680	8.43	214	.562	217
10	254	1805	819	"	2817	1278	1900	862	7.45	189	.392	220
11	279	2043	927	"	3406	1545	2300	1043	6.60	168	.287	225
12	305	2278	1033	"	4052	1838	2700	1225	5.94	151	.220	229
13	330	2514	1140	"	4937	2239	3300	1497	5.48	139	.166	228
4	102	484	220	*EEf*	305	138	200	91	18.9	480	9.45	197
5	127	668	303	"	517	234	350	159	15.1	384	4.31	196
6	152	929	421	"	873	396	600	272	12.7	323	2.12	203
7	178	1252	568	"	1337	606	900	408	10.4	264	1.16	211
8	203	1510	685	"	1751	794	1200	544	8.99	228	.749	220
9	229	1725	782	"	2221	1007	1500	680	7.83	199	.522	225
10	254	1960	889	"	2817	1278	1900	862	6.97	177	.367	227
11	279	2192	994	"	3406	1545	2300	1043	6.28	160	.273	231
12	305	2430	1102	"	4052	1838	2700	1225	5.67	144	.210	234
13	330	2680	1216	"	4937	2239	3300	1497	5.21	132	.158	234
4	102	504	229	*EEE*	305	138	200	91	18.6	472	9.32	203
5	127	696	316	"	525	238	350	159	14.8	376	4.24	204
6	152	973	441	"	873	396	600	272	12.5	317	2.08	212
7	178	1314	596	"	1337	606	900	408	10.3	262	1.14	218
8	203	1611	731	"	1751	794	1200	544	8.87	225	.739	229
9	229	1877	851	"	2221	1007	1500	680	7.73	196	.515	234
10	254	2116	960	"	2817	1278	1900	862	6.90	175	.363	235
11	279	2348	1065	"	3407	1545	2300	1043	6.23	158	.271	237
12	305	2579	1170	"	4052	1838	2700	1225	5.64	143	.209	239
13	330	2832	1285	"	4937	2239	3300	1497	5.18	132	.157	239

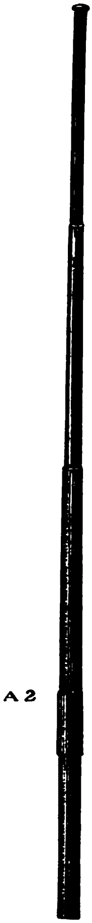
"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*

Length of Pole—40 Feet (12.192 meters)

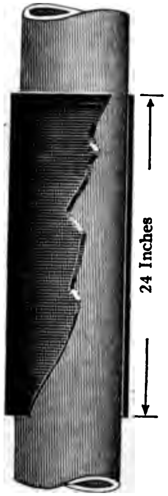
Sections: 21 feet, 10 feet, 7 feet and 6 feet 6 inches (6.401 meters, 3.048 meters, 2.134 meters and 1.981 meters)

Number	Size of Butt		Weight		Thickness	Maximum Load *P*		Load for Deflection *D* *L*		Deflection for Load *L* *D*		Factor *R*	Fa
	Ins.	m/m	Lbs.	Kilos		Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m		
8427	5	127	505	229	*ffff*	377	171	250	113	16.2	411	6.47	
8428	6	152	670	304	"	588	267	400	181	13.3	338	3.33	
8429	7	178	856	388	"	844	383	550	249	10.6	269	1.93	
8430	8	203	1064	482	"	1164	528	800	363	9.68	246	1.21	
8431	9	229	1286	583	"	1548	702	1000	454	8.05	204	.805	
8432	10	254	1542	699	"	2070	939	1400	635	7.53	191	.538	
8433	11	279	1786	810	"	2557	1160	1700	771	6.63	168	.390	
8434	12	305	2001	908	"	3034	1376	2000	907	5.98	152	.299	
8435	13	330	2225	1009	"	3687	1672	2500	1134	5.63	143	.225	
8436	5	127	629	285	*Efff*	413	187	280	127	14.9	378	5.33	
8437	6	152	871	395	"	701	318	450	204	11.7	297	2.60	
8438	7	178	1160	526	"	1092	495	750	340	10.7	272	1.43	
8439	8	203	1374	623	"	1569	712	1000	454	9.23	234	.923	
8440	9	229	1597	724	"	2153	977	1400	635	8.83	224	.631	
8441	10	254	1841	835	"	2730	1238	1800	816	7.88	200	.438	
8442	11	279	2090	948	"	3302	1498	2200	998	7.06	179	.321	
8443	12	305	2333	1058	"	3927	1781	2600	1179	6.37	162	.245	
8444	13	330	2593	1176	"	4785	2170	3200	1451	5.89	150	.184	
8445	5	127	671	304	*EEff*	431	195	280	127	13.9	353	4.96	
8446	6	152	930	422	"	803	364	550	249	13.3	338	2.42	
8447	7	178	1256	570	"	1296	588	850	386	11.2	284	1.32	
8448	8	203	1519	689	"	1697	770	1100	499	9.28	236	.844	
8449	9	229	1745	791	"	2153	977	1400	635	8.18	208	.584	
8450	10	254	1989	902	"	2730	1238	1800	816	7.38	187	.410	
8451	11	279	2232	1012	"	3302	1498	2200	998	6.71	170	.305	
8452	12	305	2478	1124	"	3927	1781	2600	1179	6.08	154	.234	
8453	13	330	2751	1248	"	4785	2170	3200	1451	5.60	142	.175	
8454	5	127	690	313	*EEEf*	509	231	350	159	16.9	429	4.84	
8455	6	152	960	435	"	846	384	550	249	13.0	330	2.37	
8456	7	178	1298	589	"	1296	588	850	386	11.0	279	1.29	
8457	8	203	1587	720	"	1697	770	1100	499	9.09	231	.826	
8458	9	229	1846	837	"	2153	977	1400	635	8.02	204	.573	
8459	10	254	2092	949	"	2730	1238	1800	816	7.25	184	.403	
8460	11	279	2336	1060	"	3302	1498	2200	998	6.60	168	.300	
8461	12	305	2578	1169	"	3927	1781	2600	1179	6.01	153	.231	
8462	13	330	2852	1294	"	4785	2170	3200	1451	5.57	141	.174	
8463	5	127	702	318	*EEEE*	509	231	350	159	16.9	429	4.83	
8464	6	152	978	444	"	846	384	550	249	13.0	330	2.36	
8465	7	178	1325	601	"	1296	588	850	386	11.0	279	1.29	
8466	8	203	1625	737	"	1697	770	1100	499	9.08	231	.825	
8467	9	229	1909	866	"	2153	977	1400	635	8.01	203	.572	
8468	10	254	2187	992	"	2730	1238	1800	816	7.25	184	.403	
8469	11	279	2432	1103	"	3302	1498	2200	998	6.60	168	.300	
8470	12	305	2674	1213	"	3927	1781	2600	1179	6.01	153	.231	
8471	13	330	2944	1335	"	4785	2170	3200	1451	5.57	141	.174	

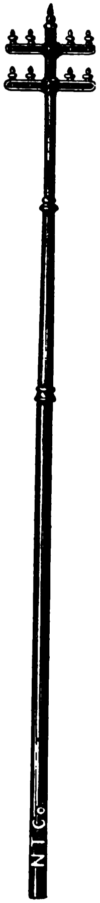
"NATIONAL" WROUGHT STEEL TUBULAR POLES.—*Continued*



Pole with Patent
Protecting
Sleeve



Patent
Protecting
Sleeve



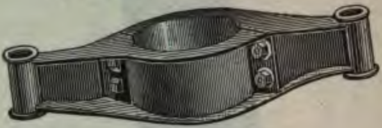
Telegraph Pole
Fitted with
Cross Arms

leeves for protection against weakening corrosion at the ground line can **applied to all poles.** See page 443. When ordering poles with protecting **ve, specify the distance** from bottom of sleeve to butt end of pole.

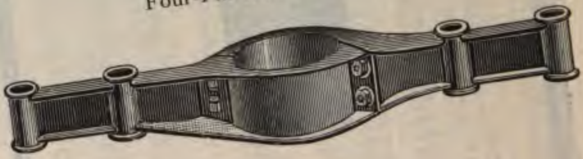
POLE FITTINGS

MALLEABLE IRON FEEDER ARMS

Two-Pin Iron Feeder Arm



Four-Pin Iron Feeder Arm

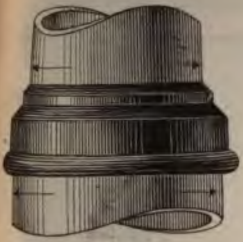


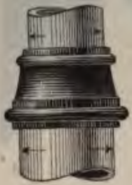
Six-Pin Iron Feeder Arm

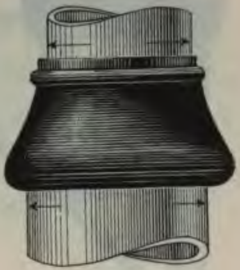
All the above Feeder Arms made for 3 in. (76.2 m/m), 4 in. (
4½ in. (114.3 m/m), 5 in. (127.0 m/m), 6 in. (152.4 m/m) and 7 in.
pipe.

POLE FITTINGS.—*Continued*

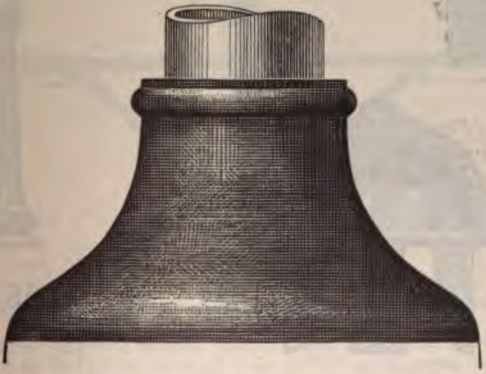
RINGS OR JOINT CASTINGS







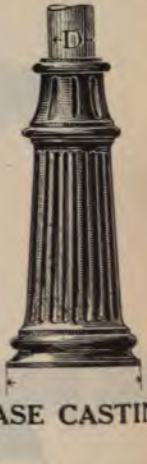
WHEEL GUARD



Rings or Joint Castings and Wheel Guards furnished in accordance with pole requirements.

Pole Fittings.—*Continued*

POLE TOPS

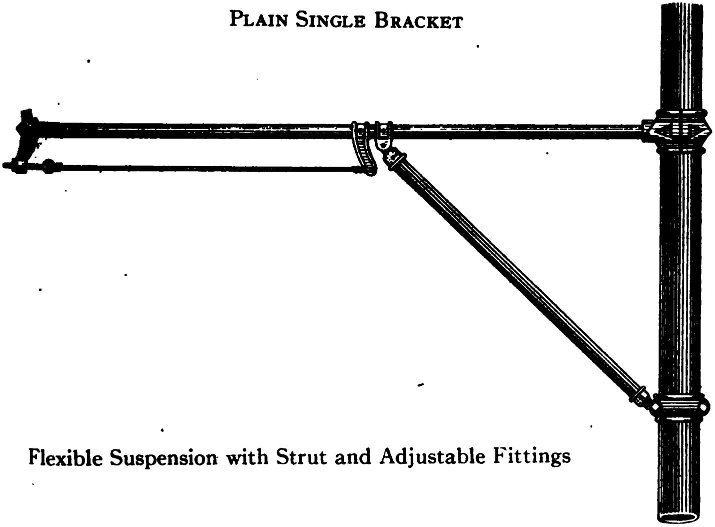


BASE CASTING

Pole Tops and Base Castings furnished in accordance with pole requirements.

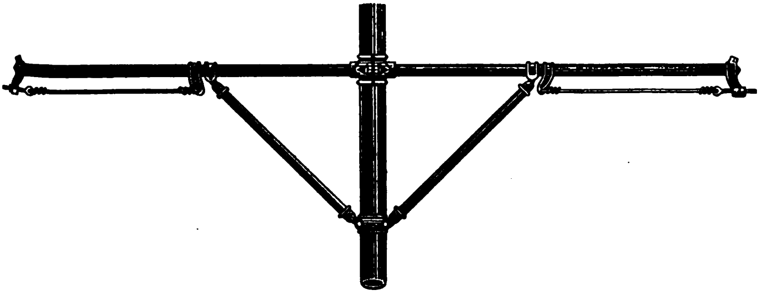
POLE BRACKETS

PLAIN SINGLE BRACKET



Flexible Suspension with Strut and Adjustable Fittings

PLAIN DOUBLE BRACKET



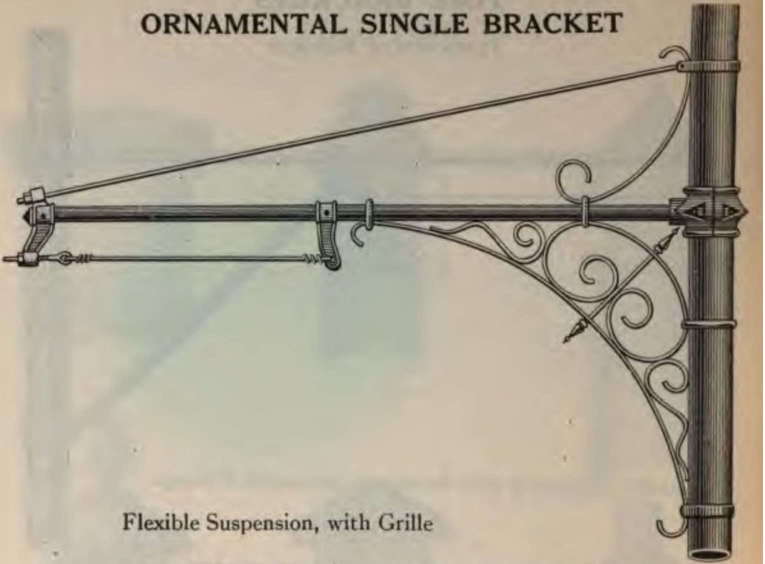
Flexible Suspension with Struts and Adjustable Fittings

These Brackets, single or double, can be made to fit 4 in. (101.6 m/m), 5 in. (127.0 m/m), 6 in. (152.4 m/m) and 7 in. (177.8 m/m) pipe, with arms made from 1½ in. (38.1 m/m) or 2 in. (50.8 m/m) pipe, 7 to 10 feet (2.134 to 3.048 meters) long.

Single and Double Brackets can be furnished with Stay Rods.

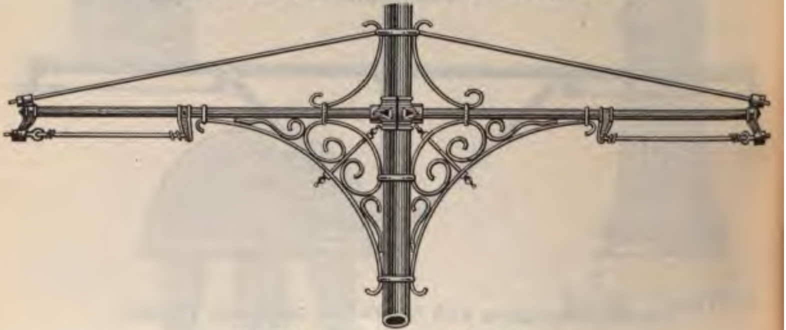
Pole Brackets.—*Continued*

ORNAMENTAL SINGLE BRACKET



Flexible Suspension, with Grille

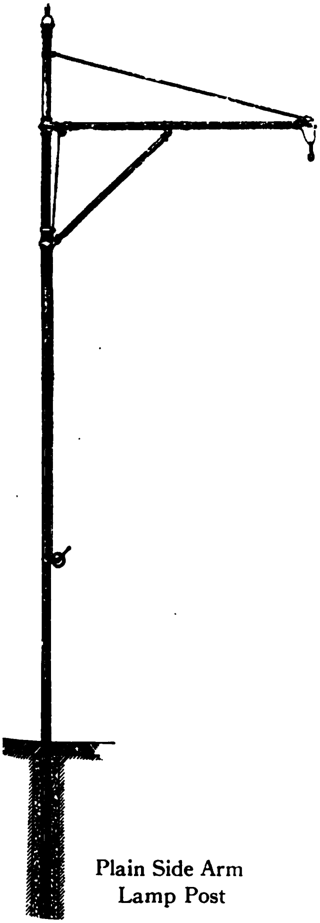
ORNAMENTAL DOUBLE BRACKET



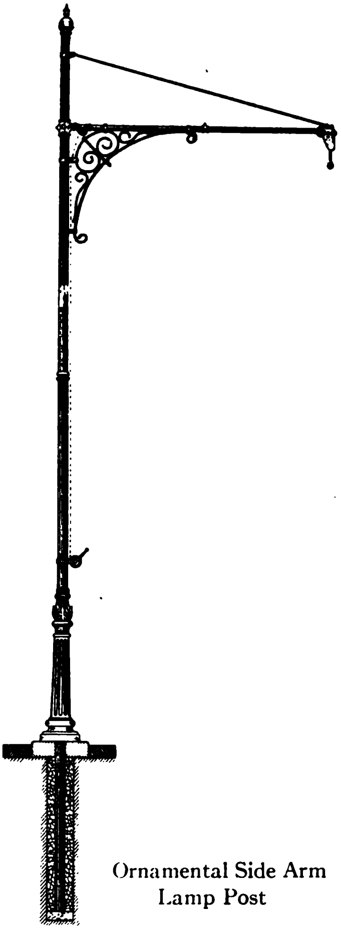
Flexible Suspension, with Grille

These Brackets, single or double, can be made to fit 4 in. (101.6 m/m), 5 in. (127.0 m/m), 6 in. (152.4 m/m) and 7 in. (177.8 m/m) pipe, with arms made from 1½ in. (38.1 m/m) or 2 in. (50.8 m/m) pipe, 7 to 10 feet (2.134 to 3.048 meters) long.

TUBULAR LAMP POSTS



Plain Side Arm
Lamp Post



Ornamental Side Arm
Lamp Post

Lamp Posts can be arranged to operate lamp from inside of Base Casting.

These Lamp Posts can be made in two or three sections from Standard Weight or Extra Strong Pipe, in accordance with requirements.

We are also prepared to furnish Lamp Posts in other ornamental designs.

BRITISH STANDARD SPECIFICATIONS FOR TUBULAR POLES

AUGUST, 1904

1. The Poles shall be of mild steel free of all defects and shall be of th classes: Light Pole, Medium Pole and Heavy Pole.

2. The Sectional Poles shall be either solid drawn, or lap-welded wrou steel, free of all defects, made up in three sections, swaged together when so as to make a perfect joint. The lap-welded seams in the sections shall set at an angle of one hundred and twenty degrees (120°) from each other.

The Taper Poles shall be of wrought steel, free of all defects, rolled in length and butt-welded the entire length. The butt-welding shall be car out at an even temperature without over heating and no Pole shall show signs of burning at the weld.

3. The over-all length of Poles of all classes shall be thirty-one feet (31

4. The length of the telescope joint in the Sectional Pole shall be eight inches (18 ins.).

5. The length of the sections shall be:

Top section	8 feet 6 inches
Middle section	8 feet 6 inches
Bottom section	17 feet

6. The outside diameters, in inches, of the three classes of both Secti and Taper Poles, shall be:

SECTIONAL POLES

Class	Top	Middle	Bottom
Light	5½ ins.	6½ ins.	7½ ins.
Medium	6½ ins.	7½ ins.	8½ ins.
Heavy	7½ ins.	8½ ins.	9½ ins.

TAPER POLES

Class	Top	Outside Diameter 9 Feet 6 Inches from Base
Light	4¾ ins.	7½ ins.
Medium	5¾ ins.	8½ ins.
Heavy	6¾ ins.	9½ ins.

7. The thickness of metal in any Pole shall be not less than one-quar of an inch (¼ in.).

8. The completed Poles shall be straight and true over their entire len to within one quarter of an inch (¼ in.).

9. The section of any Pole shall be as nearly circular as possible, not va ing in diameter by more than one-sixteenth of an inch (1/16 in.) from the adop standard.

10. Five per cent (5%) of each class of Sectional Pole shall be subjected the following drop test:

BRITISH SPECIFICATIONS FOR TUBULAR POLES.—*Continued*

The Pole shall be dropped vertically, butt downwards, three times in succession, from a height of six feet on to a hardwood block six inches thick laid on a concrete foundation, without showing any signs of telescoping or loosening of joints.

11. Five per cent. (5%) of each class of both Sectional and Taper Pole shall be subjected to the following bending tests:

The Pole shall, in each case, be rigidly supported for six feet from the butt, and loaded, as a cantilever, eighteen inches (18 ins.) from the top, the load being applied at right angles to the axis of the Pole which shall be fixed horizontally. Upon the application of the following loads in pounds, the temporary deflection and permanent set, measured at the point of application of the load, shall not exceed the figures stated in the tables.

Class of Pole	Load in Pounds for Temporary Deflection not Exceeding 6 Inches	Load in Pounds for Permanent Set not Exceeding ½ Inch
Light	750 lbs.	1000 lbs.
Medium	1250 lbs.	1750 lbs.
Heavy	2000 lbs.	2500 lbs.

12. In the event of any Pole of the above mentioned five per cent. (5%) not fulfilling the test requirements, a further five per cent. (5%) shall be subjected to the tests enumerated above. Should any further failure occur, the whole parcel from which the Poles have been selected shall be liable to rejection.

13. The maker, at his own expense, and to the satisfaction of the engineer, shall provide all the necessary testing apparatus at his own works, for carrying out the above mentioned tests.

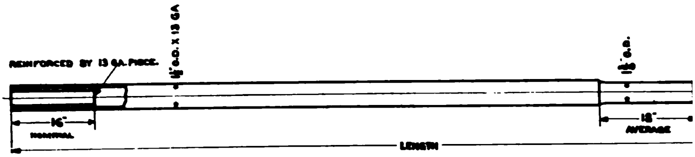
NOTE: Lap-welded Sectional Poles, conforming to the above British specifications are made of the following construction:

Class of Pole	Top Section			Middle Section			Bottom Section			Approximate Weight, Pounds
	O. D. Inches	Thickness, Inch	Length Feet	O. D. Inches	Thickness, Inch	Length Feet	O. D. Inches	Thickness, Inch	Length Feet	
Light Poles	5.5	.250	8.5	6.5	.250	8.5	7.5	.286	17.0	636
Medium "	6.5	.250	8.5	7.5	.278	8.5	8.5	.375	17.0	878
Heavy "	7.5	.250	8.5	8.5	.316	8.5	9.5	.4375	17.0	1119

SEAMLESS TROLLEY POLES

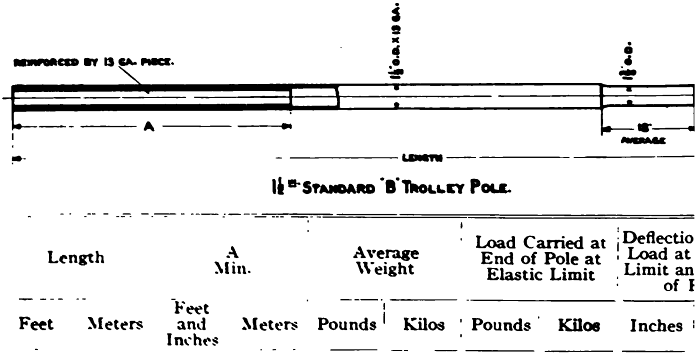
STANDARD SPECIFICATIONS FOR "SHELBY" SEAMLESS COLD DRAWN STEEL TROLLEY POLES

"SHELBY" TROLLEY POLE SPECIFICATION NO. 1-A OF
JANUARY 1, 1919



1½" STANDARD "A" TROLLEY POLE.

Length		Average Weight		Load Carried at End of Pole at Elastic Limit		Deflection Load at E Limit and of Pol
Feet	Meters	Pounds	Kilos	Pounds	Kilos	Inches
12	3.658	18.4	8.35	48	21.77	13¼
13	3.963	20.3	9.21	44	19.96	15¼
14	4.267	22.3	10.12	40	18.14	17¾
15	4.572	24.3	11.02	36	16.33	19½



1½" STANDARD "B" TROLLEY POLE.

Length		A Min.		Average Weight		Load Carried at End of Pole at Elastic Limit		Deflectio Load at Limit an of I
Feet	Meters	Feet and Inches	Meters	Pounds	Kilos	Pounds	Kilos	Inches
12	3.658	4'—6"	1.372	22.7	10.30	75	34.02	22½
13	3.963	4'—10"	1.473	24.7	11.20	69	31.30	26½
14	4.267	5'—3"	1.600	26.7	12.11	62	28.12	30
15	4.572	5'—8"	1.727	28.7	13.02	55	24.95	33

SEAMLESS TROLLEY POLES.—*Continued*

The Standard "Shelby" Seamless Steel Trolley Pole is regularly manufactured in two designs—Standard "A" and Standard "B" Pole, from 13 gauge material. Each type is reinforced, as shown in the illustration, and by the new method of insertion this reinforcement becomes practically integral with the body of the pole.

The length of reinforcement is varied to meet the requirements of strength. In the Standard "A" Pole, the reinforcement is of sufficient length to prevent deformation of the circular section by the stresses caused in service or by the clamp on the trolley base. This is the lightest pole practicable for use, and is suitable for all ordinary service.

The Standard "B" design has a reinforcement of maximum length, and is intended to meet the most severe service conditions.

Externally the two designs are duplicates, and the difference lies in the additional strength due to the reinforcement and the greater severity of the test on the Standard "B" Pole. Both are made from the same selected grade of basic open hearth steel of about .17 per cent. carbon, low in phosphorus and sulphur. Prior to the last cold-drawing operation, the material is given a special heat treatment which gives the grain the best condition. The elastic limit in the finished pole is from 60,000 to 70,000 pounds per square inch.

Every individual "Shelby" Seamless Steel Trolley Pole is subjected to a test which approximates service stresses, in a specially designed machine. This machine infallibly indicates the presence of a permanent "set" in the material, or any other imperfections which would impair the usefulness of a pole. *Any pole which does not withstand the test conditions is rejected.*

SHIFFLER POLES

MANUFACTURED BY AMERICAN BRIDGE COMPANY

These poles are designed for high voltage transmission lines, and also for trolley or electric tram, telegraph and telephone line service; they are light, strong and economical.

The standard "Shiffler" poles are made in six over all lengths of 50' 0" (15.24 M), 45' 0" (13.72 M), 40' 0" (12.19 M), 35' 0" (10.67 M), 30' 0" (9.14 M) and 24' 9" (7.54 M) and the standard light "Shiffler" poles are made in three over all lengths of 35' 0" (10.67 M), 30' 0" (9.14 M) and 24' 9" (7.54 M).

Figures 1 to 6, inclusive, show the standard poles with concrete footings and figure 6-A shows typical design for an earth footing. Figure 19 shows the light "Shiffler" poles with concrete footings. These light poles can also be furnished with earth footings similar to that shown in figure 6-A.

STUBS

It is often desired to erect poles without the necessity of guying during the setting of the concrete. In order to meet these conditions, we have designed a concrete stub. This stub is shown in figure 15 and is styled type "Q". These stubs should be shipped in advance of the poles proper.

Occasionally earth stubs are desirable in order to allow the newly tamped earth time to settle and become compact before subjected to the strains due to high winds. Our standard earth stub type "R" is shown in figure 16.

In order to place these stubs plumb, a light dummy pole either of wood or steel should be used. This dummy should be six to eight feet (1.83 M to 2.44 M) long and should be arranged to bolt to the holes in the tops of the stub angles.

ROCK ANCHORS

When poles are to be set in rock, that is—solid rock, it will be more economical to drill holes for rock anchors than to blast out a large hole to take the pole. Our standard rock anchor, type "O," shown in figure 17, is designed to meet this condition.

Swedged bolts, the diameters of which are proportioned for the type pole used are upset and flattened at the tops and forged to fit the bottoms of the pole angles. These bolts should be grouted into drilled holes and plumbed by using the dummy pole used for plumbing the stubs.

SHIFFLER POLES.—*Continued*

GROUND WIRE CLAMPS

Our standard ground wire clamp, type "N," shown in figure 14, is composed of a link and ordinary "U" bolt. This clamp is very efficient. We can, however, arrange tops of poles to suit any desired ground wire clamp, and, in cases where ground wire is not used, tops of poles can be arranged to take insulators.

CROSS ARMS

Perhaps the most important parts of a pole, and undoubtedly the parts having the most variation, are the cross arms. This is due to the fact that the cross arms are governed by the distance between wires and types of insulators used.

The distance between wires is influenced by many combinations of conditions. These distances between wires and the types of insulators are usually determined by the Electrical Engineer.

In order to allow flexibility in the determination of wire spacing, we have shown a special cross arm, type "J," in figure 11. When specifying this cross arm, which can be made projecting out both sides of pole, or on one side only, a sketch must accompany inquiry.

In order to standardize, as much as possible, cross arms for the numerous ordinary cases which occur, we have designed the cross arms shown in figures 8, 9 and 10. Cross arms G-1, G-2 and G-3 should be used with cross arms H-1 H-2 and H-3 for single circuit three phase lines and cross arms H-1, H-2 and H-3 and S-1, S-2 and S-3 should be used for two circuit three phase lines. If two ground wires are desired, they should be attached to cross arms H-1, H-2 or H-3.

The dimensions of the cross arms are based on pole spacing of about two hundred and fifty to three hundred and fifty feet.

Cross arms G-1, H-1 and S-1 are for voltages up to 22,000; G-2, H-2 and S-2 for voltages from 22,000 to 44,000 and G-3, H-3 and S-3 for voltages from 44,000 to 66,000.

Cross arms for hanging insulators should be similar to those shown, except the braces would be above instead of below the cross arms. However, as hanging insulators are not so generally used on pole lines, we have designed no standard type.

SHIFFLER POLES.—*Continued*

TELEPHONE BRACKETS

Figure 12 shows standard telephone bracket, type "K," and figure 13 shows standard telephone transposition bracket, type "M." When specifying telephone brackets, give size of holes required for insulator pins, also specify what percentage of poles should have transposition brackets.

LIGHT "SHIFFLER" POLES

The light "Shiffler" poles, shown in figure 19, are designed especially for trolley poles and for carrying telegraph and telephone wires. These poles can be arranged to take standard wooden cross arms, steel cross arms or special trolley brackets.

FOUNDATIONS

One of the most important features of line construction is the foundations of the poles. For the best construction, concrete footings are recommended when the cost will not be excessive. Earth footings, however, give good results where the ground is firm, well drained and thoroughly tamped. In soft soils the length of imbedded portions should be increased, if necessary, resorting to special grillages in extreme cases.

GALVANIZING

Unless otherwise specified, all poles and cross arms are galvanized by the hot process and all bolts are sherardized.

PAINTING

If poles are desired painted, they will receive, unless otherwise specified, one coat of standard black graphite paint. If painted poles are to have earth footings, standard earth stubs (see figure 16) should be specified. These stubs should be galvanized.

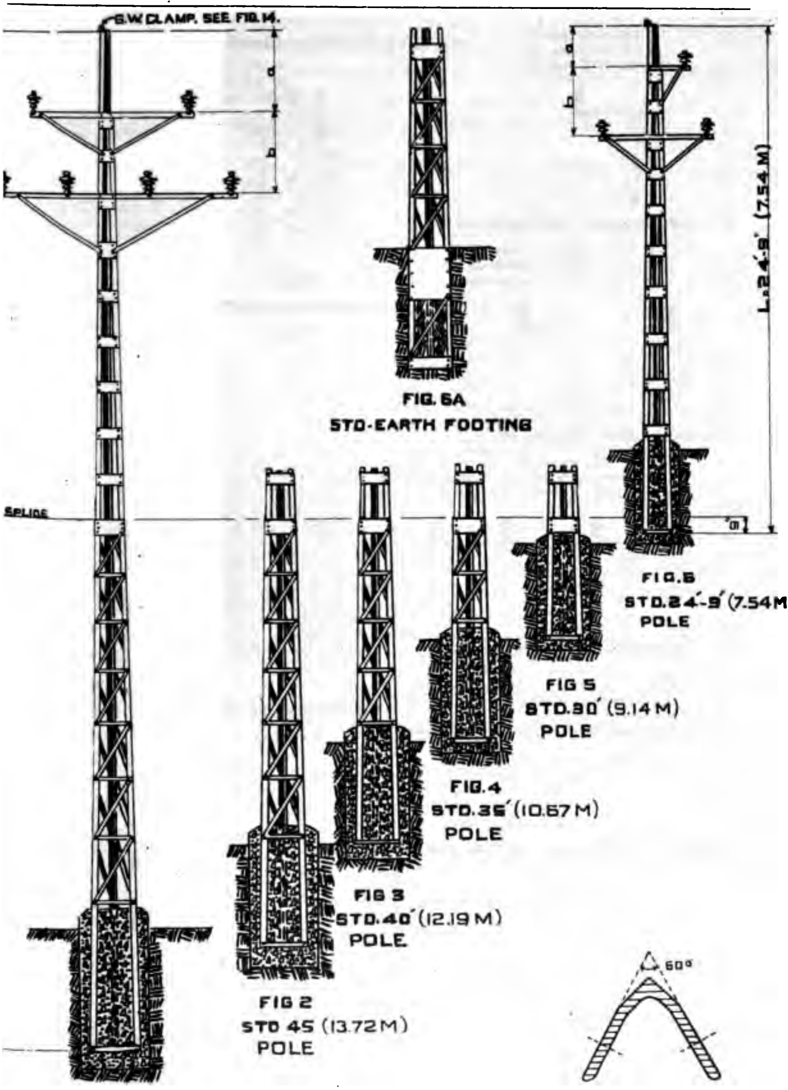


FIG. 6A
STD-EARTH FOOTING

FIG. 6
STD. 24'-9" (7.54M)
POLE

FIG 5
STD. 30' (9.14 M)
POLE

FIG. 4
STD. 35' (10.67 M)
POLE

FIG 3
STD. 40' (12.19 M)
POLE

FIG 2
STD 45 (13.72 M)
POLE

FIG. 1
STD. 50 (15.24 M)
POLE

FIG. 7
STD. 60° SHIFFLER ANGLE
PAT. APPL'D FOR

SHIFFLER POLES.—*Continued*

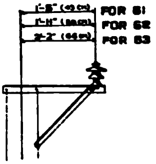


FIG 8

STD. CROSS ARM TYPES G1. G2, G3.

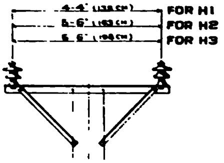


FIG 9

STD. CROSS ARM. TYPES H1. H2; H3.

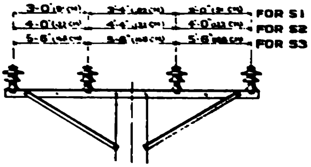


FIG. 10

STD. CROSS ARM. TYPES S1, S2, S3.

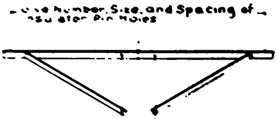


FIG. 11

SPECIAL MULTI-WIRE CROSS ARM. TYPE J.

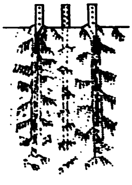


FIG. 17

STD. ROCK ANCHORS

TYPE O.

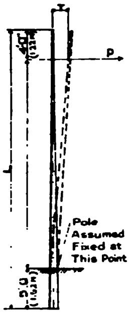


FIG. 18

SHOWING POSITION OF SAFE LOAD P GIVEN IN TABLES.

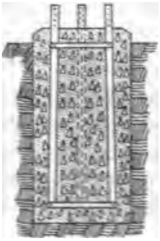


FIG. 15

STD CONCRETE STUB

TYPE Q.

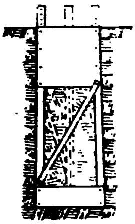


FIG. 16

STD. EARTH STUB

TYPE R.

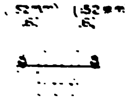


FIG. 12

STD. TELEPHONE BRACKET, TYPE K.

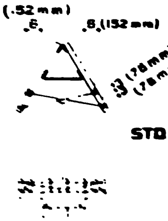


FIG. 13

STD. TELEPHONE TRANSPOSITION BRACKET, TYPE M.

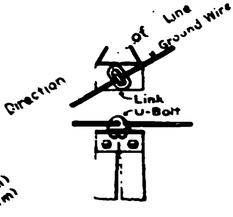


FIG. 14

STD GROUND WIRE CLAMP, TYPE N.

PATENTED.

SHIFFLER POLES.—*Continued*

TYPE A-A—Leg angles for 24′ 9″ poles, 2½ x 2½ x 3/16; Leg angles for all other lengths, top 2½ x 2½ x 3/16, bottom 3 x 3 x 3/16.

Length—L		Safe Load—P		Deflection-T Due to P		*Weight of Pole like Figs. 1–6 for Concrete Footing				*Weight of Pole like Figs. 6-A forEarth Footing			
						Galvanized		Painted		Galvanized		Painted	
Feet	Meters	Lbs.	Kilos	Ins.	m/m	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos
24¾	7.54	1100	499	3.5	89	400	181	390	177	560	254	545	247
30	9.14	1100	499	5.5	140	517	235	502	228	680	308	661	300
35	10.67	1100	499	7.0	178	613	278	596	270	840	381	816	370
40	12.19	1100	499	8.5	216	724	328	703	319	1006	456	979	444
45	13.72	1100	499	9.5	241	833	378	809	367	1190	540	1158	525
50	15.24	1100	499	11.0	279	914	415	892	405	1359	616	1323	601

TYPE A—Leg angles for 24′ 9″ poles, 3 x 3 x 3/16; Leg angles for all other lengths, top 3 x 3 x 3/16, bottom 3½ x 3½ x 3/16.

24¾	7.54	1530	694	3.5	89	460	209	450	204	550	249	530	240
30	9.14	1530	694	5.5	140	610	277	590	268	770	349	750	340
35	10.67	1530	694	7.0	178	730	331	710	322	940	426	910	413
40	12.19	1500	680	8.5	216	860	390	840	381	1120	508	1090	494
45	13.72	1430	649	9.5	241	1000	454	980	445	1330	603	1300	590
50	15.24	1390	631	11.0	279	1110	504	1090	494	1530	694	1500	680

TYPE B—Leg angles for 24′ 9″ poles, 3 x 3 x ¼; Leg angles for all other lengths, top 3 x 3 x ¼, bottom 3½ x 3½ x ¼.

24¾	7.54	2030	921	3.5	89	550	249	540	245	640	290	620	281
30	9.14	2030	921	5.5	140	720	327	700	318	880	399	860	390
35	10.67	2030	921	7.0	178	870	395	850	386	1080	490	1050	476
40	12.19	1980	898	8.5	216	1020	463	1000	454	1280	581	1250	567
45	13.72	1880	853	9.5	241	1180	535	1150	522	1510	685	1470	667
50	15.24	1830	830	11.0	279	1310	594	1280	581	1730	785	1690	767

TYPE C—Leg angles for 24′ 9″ poles, 3 x 3 x 5/16; Leg angles for all other lengths, top, 3 x 3 x 5/16, bottom 3½ x 3½ x 5/16.

24¾	7.54	2500	1134	3.5	89	640	290	620	281	730	331	700	318
30	9.14	2500	1134	5.5	140	830	376	810	367	990	449	970	440
35	10.67	2500	1134	7.0	178	1000	454	980	445	1210	549	1180	535
40	12.19	2430	1102	8.5	216	1180	535	1150	522	1440	653	1400	635
45	13.72	2300	1043	9.5	241	1360	617	1330	603	1690	767	1650	748
50	15.24	2250	1021	11.0	279	1510	685	1480	671	1930	875	1890	857

TYPE D—Leg angles for 24′ 9″ poles, 3 x 3 x ⅜; Leg angles for all other lengths, top, 3 x 3 x ⅜, bottom 3½ x 3½ x ⅜.

24¾	7.54	2970	1347	3.5	89	720	327	700	318	810	367	780	354
30	9.14	2970	1347	5.5	140	940	426	920	417	1100	499	1080	490
35	10.67	2970	1347	7.0	178	1130	513	1100	499	1340	608	1300	590
40	12.19	2880	1306	8.5	216	1320	599	1290	585	1580	717	1540	699
45	13.72	2740	1243	9.5	241	1520	689	1490	676	1850	839	1810	821
50	15.24	2680	1216	11.0	279	1700	771	1660	753	2120	762	2070	939

STANDARD CROSS ARMS—Diameter of Hole for Insulator Pin 13/16″ (21 m/m)

	‡Section of Arm Angle	Section of Knee Brace Angle	Weight Complete Galvanized		Weight Complete Painted		Std. Distance (a) See Fig. 1		Std. Distance (b) See Fig. 1	
			Lbs.	Kilos	Lbs.	Kilos	Ins.	m/m	Ins.	m/m
G1	3x2½x¼	1¾x1¼x3/16	14	6.4	13	5.9	30	762	..	....
G2	4x3 x¼	1¾x1¼x3/16	20	9.1	19	8.6	36	914	..	....
G3	5x3 x5/16	1¾x1¼x3/16	30	13.6	29	13.2	42	1067	..	....
H1	3x2½x¼	1¾x1¼x3/16	32	14.5	31	14.1	30	762	36	914
H2	4x3 x¼	1¾x1¼x3/16	46	20.9	45	20.4	36	914	48	1219
H3	5x3 x5/16	1¾x1¼x3/16	73	33.1	71	32.2	42	1067	60	1524
S1	3x3 x¼	1¾x1¾x3/16	72	32.7	70	31.8	..	....	36	914
S2	4x3 x5/16	2 x2 x3/16	126	57.1	123	55.8	..	....	48	1219
S3	5x3½x5/16	2½x2½x3/16	202	91.6	196	88.9	..	....	60	1524
J	Depends on Size						No Standard			

(*) **Weight does not** include cross arms. ‡Short legs of angles are placed vertically.

SHIFFLER POLES.—*Continued*

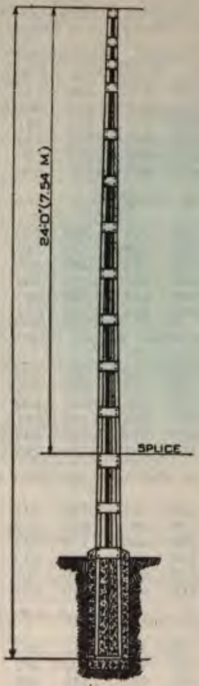


FIG. 19
LIGHT SHIFFLER
POLES, TYPES U & V

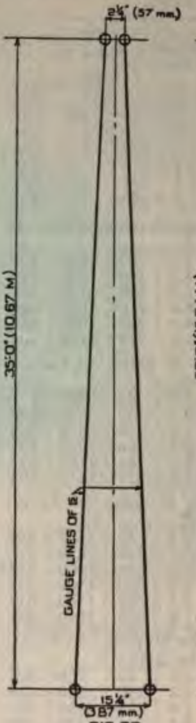


FIG. 20
SLOPE OF LEGS
LIGHT POLES, TYPES
U & V

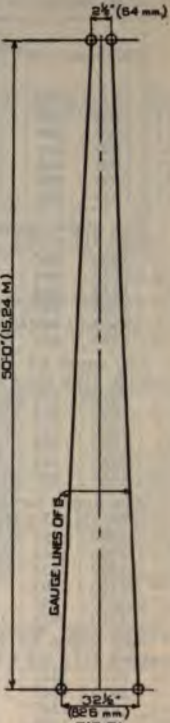


FIG 21
SLOPE OF LEGS
STD. POLES, TYPES
A, B, C, D, E & F

LIGHT SHIFFLER POLES, TYPE U—Leg angles for 24′ 9″ poles, 2½x2½x$\frac{3}{16}$; Leg angles for all other lengths, top 2½x2½x$\frac{3}{16}$, bottom 3x3x$\frac{3}{16}$.

Length—L		Safe Load—P		Deflec-tion—T Due to P		*Weight of Pole like Figs. 1–6 for Concrete Footing				*Weight of Pole like Fig. 6-A for Earth Footing			
						Galvanized		Painted		Galvanized		Painted	
Feet	Meters	Lbs.	Kilos	Ins.	mm.	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilos	Lbs.	Kilo
24¾	7.54	820	372	5.0	127	370	168	360	163	460	209	450	204
30	9.14	820	372	8.5	216	480	218	470	213	590	268	580	263
35	10.67	820	372	10.5	267	580	263	570	259	710	322	700	318

LIGHT SHIFFLER POLES, TYPE V—Leg angles for 24′ 9″ poles, 2½ x 2½ x ¼; Le angles for all other lengths, top 2½ x 2½ x ¼, bottom 3 x 3 x ¼.

24¾	*7.54*	*1080*	490	5.0	127	450	204	440	200	540	245	530	240
30	*9.14*	*1080*	490	8.5	216	580	263	560	254	690	313	670	304
35	*10.67*	*1080*	490	10.5	267	700	318	680	308	830	376	810	367

**Weight does not include cross arms.*

STRUCTURAL STEEL WORK

STEEL BRIDGES—STEEL BUILDINGS
STEEL DERRICKS AND DRILLING RIGS

RUCTURAL STEEL FOR BRIDGES, BUILDINGS AND
SHIPBUILDING PURPOSES
EAMS, CHANNELS, ANGLES, TEES, Z-BARS, PLATES
OUGH PLATE AND CORRUGATED PLATE FLOORING
CHECKERED PLATE

BARS, CLEVISES, SLEEVE NUTS, STANDARD UPSETS
LOOP RODS, PINS WITH NUTS, RIVETS

ELEMENTS OF BEAMS—BEAM CONNECTIONS
RIVETED BEAM AND PLATE GIRDERS
COLUMNS AND STRUTS
SAFE LOADS ON BEAMS AND COLUMNS
LIVE LOADS ON FLOORS AND ROOFS

STEEL SHEET PILING
CONCRETE REINFORCEMENT BARS
TRIANGLE MESH CONCRETE REINFORCEMENT
CONCRETE PAVEMENT AND ROADWAYS

STRUCTURAL STEEL WORK

We are prepared to submit Designs and Estimates (either for the steel work prepared ready for erection or erected complete on the site of the structure) for Bridges and Steel Buildings of all kinds:

Draw Bridges, Highway, Railway and Foot Bridges of Plate Girder, Riveted or Pin Design; Suspension Bridges; Turn Tables;

Steel Viaducts and Elevated Railways;

Steel Buildings of all kinds for Railway, Manufacturing and Industrial purposes; Hotels, Office Buildings, Railway Stations and Terminals; Train and Locomotive Sheds; Freight Sheds; Electric Power Houses; Boiler Houses and Car Barns; Sugar Houses; Cement Plants; Factories, Workshops, Machine Shops, etc., etc.;

Roof Trusses, Girders, Columns, and Punched or Drilled Shapes and Plates:

Transmission Towers for Electric Transmission Lines;

Radio Towers for Wireless Stations;

Tanks, Rivets, Riveted Pipe, Steel Hulls for River Barges and Dredges.

STEEL BRIDGES

HIGHWAY BRIDGES.—To enable us to properly design and prepare estimates for Highway Bridges, the undermentioned particulars should accompany requests for proposals:

Number of bridges.

Length of each bridge.

Whether deck or through bridge.

Type of bridge.

Number of spans.

Length of span—Clear span, or from center to center of bearings, or over all.

Clear width of roadway.

Number of sidewalks.

Width of sidewalks.

STRUCTURAL STEEL WORK.—*Continued*

STEEL BRIDGES.—*Continued*

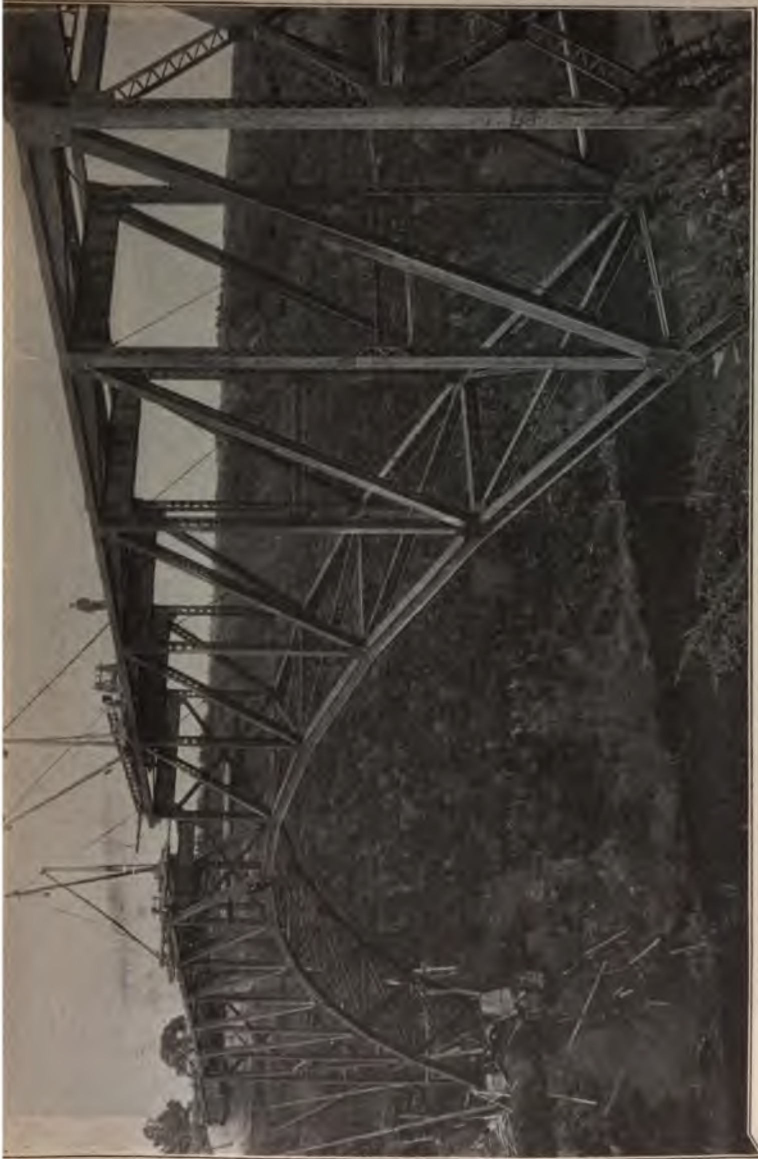
Kind of hand railing.
Clear height above roadway, if necessary.
Distance from masonry to under side of floor, if fixed.
Is bridge square or skew? If skew, give sketch.
Description of flooring.
Are stringers to be wood or steel?
Loading for bridges.
Loading for sidewalks.
Are field connections to be rivets or bolts?

RAILWAY BRIDGES.—For Standard Specifications for Steel Railway Bridges see pages 511 to 533.

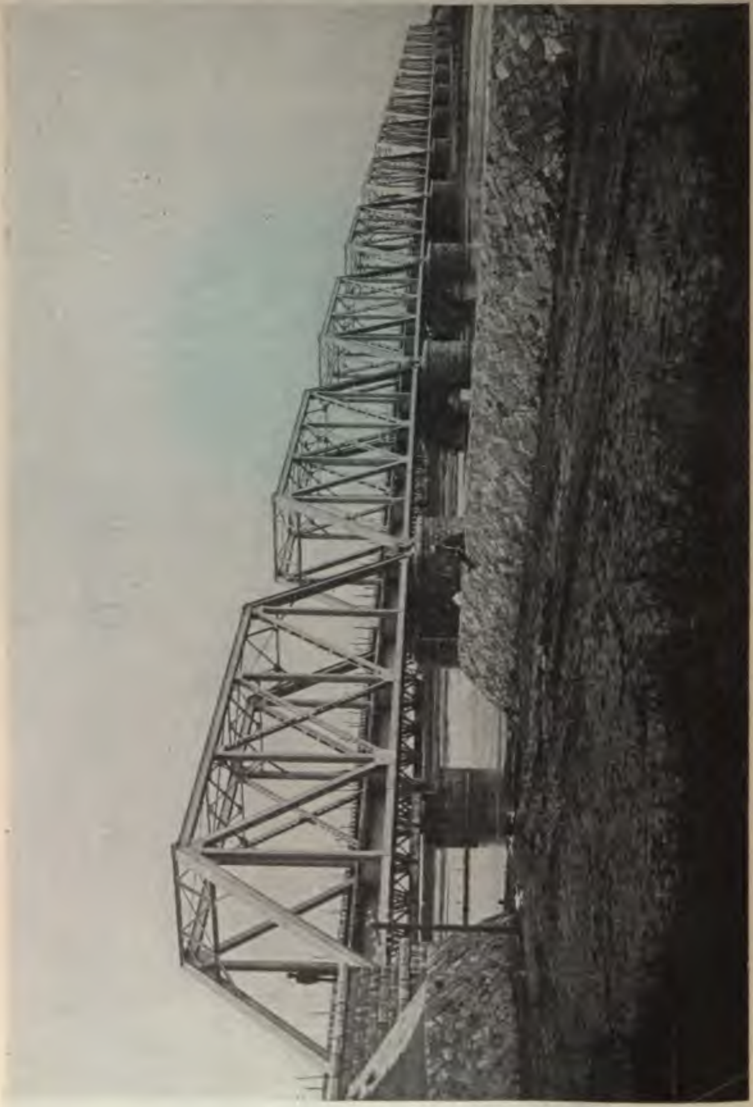
Requests for proposals for Railway Bridges should be accompanied by the under mentioned particulars, which are necessary to enable us to properly prepare designs and estimates:

Number of bridges.
Length of each bridge.
Whether deck or through bridge.
Type of bridge.
Number of spans.
Length of each span—Clear span, or from center to center of bearings, or over all.
Is bridge on a tangent or curve? If a curve, give the degree.
Clearance in bridge for train.
Distance from center to center of trusses.
Distance from top of stringer to masonry.
Distance from top of stringer to high water.
Loading for bridges, and train load.
Engine diagram.
Is bridge square or skew? If skew, give sketch.
Are field connections to be rivets or bolts?

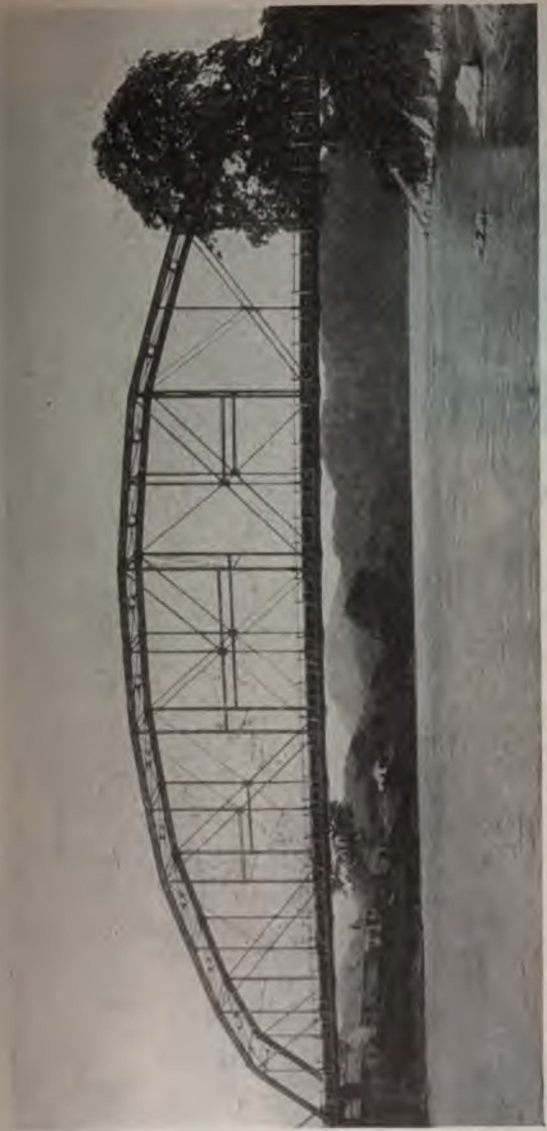
See also "Addendum to General Specifications for Steel Railway Bridges" page 534, which states a number of points to be specifically determined by buyers when soliciting proposals for steel railway bridges.



Arched Highway Bridge, Cambridge, New Zealand



Bridge over Ugakuziyo River, South Manchurian Railway



Ulua River Bridge, Honduras, C. A.

GENERAL SPECIFICATIONS FOR STEEL RAILWAY BRIDGES

AMERICAN RAILWAY ENGINEERING ASSOCIATION GENERAL SPECIFICATIONS FOR STEEL RAILWAY BRIDGES, 1910, EIGHTH EDITION

(For the equivalents, according to the Metric System, of the dimensions and weights given in the following specifications, refer to the tables on pages 14 to 28.)

PART FIRST—DESIGN

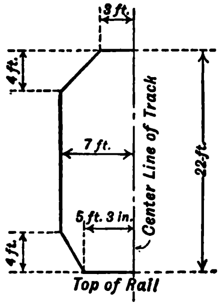
I. GENERAL

Materials

1. **The material in the superstructure shall be structural steel, except as otherwise specified.**

Clearances

2. **If the alignment is straight, clearances shall be not less than shown on the diagram.** If the alignment is curved, the width of the diagram shall be increased so as to provide the same minimum clearances for a car 80 feet long, 14 feet high and 60 feet center to center of trucks, allowance being made for curvature and superelevation of rails. The height of rail shall be assumed as 6 inches.



Spacing Trusses

3. **The width center to center of girders and trusses shall be not less than one-twentieth of the effective span,** and not less than is necessary to prevent overturning under the assumed lateral loading.

Skew Bridges

4. **In skew bridges without ballasted floors, the ends of girders and beams supporting the track shall be square with the track at the abutments.**

Floors

5. **Wooden tie floors** shall be secured to the stringers and **shall be proportioned** to carry the maximum wheel load, with **100 per cent.** impact, distributed over three ties, with fibre **stress not to exceed** 2000 pounds per square inch. Ties shall **be not less than** 10 feet in length. They shall be spaced with **not more than** 6-inch openings, and shall be secured against **bunching.**

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

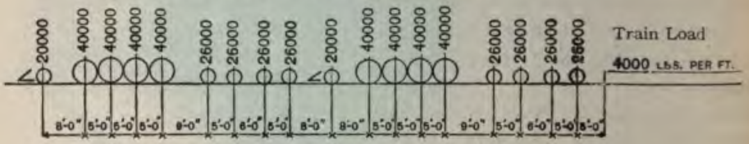
II. LOADS

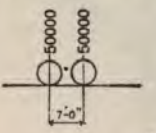
Dead Load

6. The dead load shall consist of the estimated weight of the entire suspended structure. Timber shall be assumed to weigh 4½ pounds per foot B. M.; ballast 100 pounds per cubic foot, reinforced concrete 150 pounds per cubic foot, and rail and fastenings, 150 pounds per linear foot of track.

Live Load

*7. The live load, for each track, shall consist of two typical engines followed by a uniform load, according to Cooper's series, or a system of loading giving practically equivalent stresses. The minimum loading shall be Cooper's E-40, as shown in the following diagrams:





The diagram that gives the larger stresses shall be used.

Heavier Loadings

8. Heavier loadings shall be proportional to the above loadings with the same wheel spacing.

Impact

9. The dynamic increment of the live load shall be added to the maximum computed live load stresses and shall be determined by the formula $I = S\frac{300}{L+300}$

where I = impact or dynamic increment to be added to live load stresses.

S = computed maximum live-load stress.

L = length of track in feet loaded to produce the maximum stress in the member. For bridges carrying more than one track, the aggregate length of all tracks loaded to produce the stress shall be used.

Impact shall not be added to stresses produced by longitudinal, centrifugal and lateral or wind forces.

**See Addendum, clause* (*a*), *page* 534.

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

Lateral Forces

10. All spans shall be designed for a lateral force on the loaded chord of 200 pounds per linear foot plus 10 per cent. of the specified train load on one track, and 200 pounds per linear foot on the unloaded chord: these forces being considered as moving.

Wind Force

11. Viaduct towers shall be designed for that one of the following loads, considered as moving, which gives the greater stress:

(*a*) A force of 50 pounds per square foot applied on one and one-half times the vertical projection of the tower and the portion of the structure which it supports.

(*b*) A force of 30 pounds per square foot, applied on the same surface, plus 400 pounds per linear foot of structure applied 7 feet above the top of the rail, for assumed wind force on train, when the structure is loaded, on either one or both tracks, with empty cars weighing 1200 pounds per linear foot.

Longitudinal Force

12. Viaduct towers and similar structures shall be designed for a longitudinal force of 20 per cent. of the live load applied at the top of the rail.

13. Structures on curves shall be designed for the centrifugal force of the live load applied at the top of the high rail. The centrifugal force shall be considered as live load and shall be derived from the speed in miles per hour given by the expression $60-2\frac{1}{2}D$, in which "D" = degree of curve.

III. UNIT STRESSES AND PROPORTION OF PARTS

Unit Stresses

14. Structures shall be so proportioned that the sum of the naximum stresses produced by the foregoing loads will not xceed the following amounts in pounds per square inch, xcept as modified in paragraphs 22 to 25:

Tension

15. Axial tension on net section.............16,000

Compression

16. Axial compression on gross section of columns...........................$16{,}000-70\frac{l}{r}$
ith a maximum of........................14,000
here "l" is the length of the member in inches,
and "r" is the least radius of gyration in inches.
Direct compression on steel castings..........16,000

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

Bending

17. *Bending:* on extreme fibres of rolled shapes, built sections, girders and steel castings; net section..16,000
on extreme fibres of pins.....................24,000

Shearing

18. *Shearing:* shop driven rivets and pins....12,000
field driven rivets and turned bolts............10,000
plate girder webs; gross section...............10,000

Bearing

19. *Bearing:* shop driven rivets and pins.....24,000
field driven rivets and turned bolts...........20,000
expansion rollers; per linear inch............. 600 *d*
where "*d*" is the diameter of the roller in inches.
on masonry.................................. 600

Limiting Length of Members

20. The ratio of length to least radius of gyration shall exceed 100 for main compression members nor 120 for and sway bracing.

21. The lengths of riveted tension members in horizont inclined positions shall not exceed 200 times their radiu gyration about the horizontal axis. The horizontal projec of the unsupported portion of the member shall be sidered its effective length.

Alternate Stresses

22. Members subject to alternate stresses of tension compression shall be proportioned for the kind of stress quiring the larger section. If the alternate stresses occu succession during the passage of one train, as in stiff count each stress shall be increased by 50 per cent. of the sma The connections of such members shall in all cases be portioned for the sum of the stresses so increased.

23. If the live load and dead load stresses are opposit character, only two-thirds of the dead load stress shal considered as effective in counteracting the live load st This reduction of dead load shall not be made in porport ing members subject to alternate stresses.

Combined Stresses

24. Members subject to both axial and bending stre shall be proportioned so that the combined fiber stresses not exceed the allowed axial stress.

25. Members subject to stresses produced by combinat of lateral, longitudinal, and wind forces with dead load,

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

npact, and centrifugal force, may be proportioned for 'esses 25 per cent. greater than those specified in para- 15 to 19, inclusive; but the section shall be not less ıat required for dead load, live load, impact, and gal force.

Net Section at Rivets

n proportioning tension members the diameter of the les shall be taken ⅛ inch larger than the nominal diam- he rivet.

Rivets

ı proportioning rivets the nominal diameter of the ıll be used.

Net Section at Pins

he minimum net section through the pin-hole of pin- ed riveted tension members shall be at least 25 per excess of the net section of the body of the member. ıimum net section back of the pin-hole, parallel with of the member, shall be not less than the net section ody of the member.

Plate Girders

late girders shall be proportioned either by the moment a of their net section; or by assuming that the flanges entrated at their centers of gravity. In the latter -eighth of the gross section of the web, if properly may be used as flange section. The thickness of web hall be not less than 1/160 of the unsupported dis- tween flange angles (see 38).

Compression Flange

he gross section of the compression flanges of plate hall be not less than the gross section of the tension If the compression flange of any beam or girder con- ıngles only or if the cover consists of flat plates, the r square inch shall not exceed $16{,}000-200\frac{l}{b}$. If r consists of a channel section the stress per square ıll not exceed $16{,}000-150\frac{l}{b}$. L represents the unsupported flange, and b is the flange width.

Flange Rivets

ıe flanges of plate girders shall be connected to the ı a sufficient number of rivets to transfer in a distance the effective depth of the girder at any given point, shear at that point combined with any load that is lirectly on the flange. If the ties rest on the flanges,

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

each wheel load shall be assumed to be distributed over three ties.

Depth Ratios 32. The depth of trusses shall preferably be not less than one-tenth of the span. The depth of plate girders and rolled beams, used as girders, shall preferably be not less than one-twelfth of the span. If shallower trusses, girders or beams are used, the section shall be increased so that the maximum deflection will not be greater than if the above limiting ratios had not been exceeded.

IV. DETAILS OF DESIGN

GENERAL REQUIREMENTS

Open Sections 33. Structures shall be so designed that all parts will be accessible for inspection, cleaning and painting.

Pockets 34. Pockets or depressions which would hold water shall be provided with drain holes, or be filled with waterproof material.

Symmetrical Sections 35. Main members shall be so designed that the neutral axis will be as nearly as practicable in the center of the section. The neutral axes of intersecting main members of trusses shall meet at a common point.

Counters 36. Rigid counters are preferred. If subject to reversal of stress the chord connections shall preferably be riveted. Adjustable counters shall have open turnbuckles.

Strength of Connections 37. The strength of connections shall be sufficient to develop the full capacity of the member for the kind of stress it is to carry even though the computed stress is less than such capacity.

Minimum Thickness 38. The minimum thickness of metal shall be ⅜ inch, except for fillers.

Pitch of Rivets 39. The minimum distance between centers of rivet holes shall be three diameters of the rivet; but the distance shall be preferably not less than 3 inches for ⅞-inch rivets and 2½ inches for ¾-inch rivets. The maximum pitch in the line of stress for members composed of plates and shapes shall be 6 inches for ⅞-inch rivets and 5 inches for ¾-inch rivets. For angles with two gauge lines and rivets staggered the maximum pitch in each line shall be twice the above. If two or

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

lates are used in contact, rivets not more than 12 inches in either direction shall be used to hold the plates r. In tension members composed of two angles in , a pitch of 12 inches may be used for riveting these together.

Edge Distance

he minimum distance from the center of any rivet hole eared edge shall be 1½ inches for ⅞-inch rivets and hes for ¾-inch rivets, and to a rolled edge 1¼ inches inches, respectively. The maximum distance from e shall be eight times the thickness of the plate, but t exceed 6 inches.

Maximum Diameter

he diameter of the rivets in any angle whose size is ned by calculated stress shall not exceed one-fourth width of the leg in which they are driven; in angles ize is not so determined ⅞-inch rivets may be used in gs, and ¾-inch rivets in 2½-inch legs.

Long Rivets

ivets carrying calculated stress and whose grip exceeds meters shall be increased in number at least one per each additional 1/16 inch of grip.

Pitch at Ends

he pitch of rivets at the ends of built compression s shall not exceed four diameters of the rivets, for a equal to one and one-half times the maximum width er.

Compression Members

built compression members the metal shall be cond in the webs and flanges. The thickness of each ll be not less than one-thirtieth of the distance between of rivets, connecting it to the flanges. The thickness plates shall be not less than one-fortieth of the distween the nearest rivet lines.

Minimum Angles

he minimum thickness of flange angles of girders and embers without cover plates shall be one-twelfth of h of the outstanding leg.

Tie Plates

he open sides of compression members shall be proith lacing bars and shall have tie plates as near each practicable. Tie plates shall be provided at interpoints where the lacing is interrupted. In main s the length of end tie plates shall be not less than the

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

distance between the nearest lines of rivets connecting them to the flanges, and the length of intermediate tie plates not less than one-half that distance. Their thickness shall be not less than one-fiftieth of the same distance.

Lacing

47. The lacing of compression members shall be proportioned to resist the shearing stresses corresponding to the allowance for flexure for uniform load provided in the column formula in paragraph 16 by the term $70\frac{l}{r}$. The minimum width of lacing bars shall be 2½ inches for ⅞-inch rivets, 2¼ inches for ¾-inch rivets, and 2 inches for ⅝-inch rivets if used. The thickness shall be not less than one-fortieth of the distance between end rivets for single lacing, and one-sixtieth for double lacing. Shapes of equivalent strength may be used instead of bars.

48. Five-eighths-inch rivets shall be used for lacing flanges less than 2½ inches wide, ¾-inch rivets for flanges from 2½ to 3½ inches wide, and ⅞-inch rivets for flanges 3½ inches and over in width. Lacing bars with at least two rivets in each end shall be used for flanges over 5 inches wide.

49. The inclination of lacing bars with the axis of the member shall be not less than 45 degrees. If the distance between rivet lines in the flanges is more than 15 inches, and a single rivet bar is used, the lacing shall be double and riveted at the intersections.

50. Lacing bars shall be so spaced that the portion of the flange included between their connections will be as strong as the member as a whole.

Faced Joints

51. Abutting joints in compression members faced for bearing shall be sufficiently spliced on four sides to hold the connecting members accurately in place. Other joints in riveted work, whether in tension or compression, shall be fully spliced.

Pin Plates

52. Pin-holes shall be reinforced by plates if necessary, and at least one plate shall be as wide as the flanges will allow, and be on the same side as the angles. Pin plates shall contain sufficient rivets to distribute their portion of the pin pressure to the full cross-section of the member.

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

Forked Ends

he ends of compression members shall not be forked navoidable; with forked ends, a sufficient number of es shall be provided to give the jaws twice the sectional the member. At least one of these plates shall extend ar edge of the farthest tie plate, and the others to the of the nearest tie plate, but not less than 6 inches the near edge of the farthest tie plate.

Pins

ins shall be long enough to insure a full bearing of all ts connected upon the turned body of the pin. They secured by chambered nuts or be provided with if solid nuts are used. The screw ends shall be long to admit of burring the threads.

in connected members shall be held against lateral nt on the pins.

Bolts

here members are connected by bolts, the turned f the bolts shall be long enough to extend through the A washer at least ¼ inch thick shall be used under . Bolts shall not be used in place of rivets except by permission. Heads and nuts shall be hexagonal.

Indirect Splices

splice plates are not in direct contact with the parts hey connect, rivets shall be used on each side of the excess of the number required in the case of direct to the extent of one-third of that number for each ing plate.

Fillers

here rivets carrying stress pass through fillers the hall be extended beyond the connected member and nsion secured by additional rivets equal in number to ent. of those required to carry the stress.

Expansion

rovision shall be made for expansion and contraction idge structures to the extent of ⅛ inch for each ten ength. Means shall be provided to prevent excessive at any point.

Expansion Bearings

pans of 80 feet and over resting on masonry shall have ollers or rockers at one end. Spans of less length shall nged to slide on smooth surfaces. These expansion shall be designed to permit motion in one direction

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

Fixed Bearings 61. Fixed bearings shall be firmly anchored to the supports.

Rollers 62. Expansion rollers shall be not less than 6 inches in diameter. They shall be coupled together with substantial side bars, which shall be so arranged that the rollers can be readily cleaned. Segmental rollers shall be geared to the upper and lower plates.

Bolsters 63. Bolsters or shoes shall be so constructed that the load will be distributed uniformly over the entire bearing. Spans of 80 feet and over shall have hinged bolsters at each end.

Wall Plates 64. Wall plates may be cast or built up and shall be so designed as to distribute the load uniformly over the entire bearing. They shall be secured against displacement.

Anchorage 65. Anchor bolts for viaduct towers and similar structures shall be designed to engage a mass of masonry the weight of which is at least one and one-half times the uplift.

Inclined Bearings 66. The sole plates of bridges on an inclined grade without pin shoes shall be beveled so that the masonry and expansion surfaces will be level.

FLOOR SYSTEMS

Floor Beams 67. Floor beams shall preferably be square to the girders or trusses. They shall be riveted directly to the girders or trusses or may be placed on top of deck bridges.

Stringers 68. Stringers shall preferably be riveted to the webs of intermediate floor beams by means of connection angles not less than ½-inch thick. Shelf angles or other supports provided to support the stringer during erection shall not be considered as carrying any of the reaction.

Stringer Frames 69. End floor beams shall be used if possible. Stringers resting on masonry shall be connected at their ends by cross frames. The frames shall be riveted to girders or truss shoes where practicable.

BRACING

Rigid Bracing 70. Lateral, longitudinal and transverse bracing shall be composed of rigid members.

Portals 71. The end posts and top chords of the through truss spans shall be rigidly connected by riveted portal braces. The braces shall be as deep as the clearance will allow.

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

72. An intermediate transverse frame shall be used at each panel of through spans having vertical truss members where the clearance will permit. Transverse Bracing

73. Deck spans shall have transverse bracing at each end proportioned to carry the lateral load to the support. End Bracing

74. The minimum sized angle to be used in lateral bracing shall be 3½ by 3 by ⅜ inches. There shall be not less than three rivets at each end connection of the angles. Laterals

75. Lateral bracing beneath the track shall be low enough to clear the ties.

76. The struts at the base of viaduct towers shall be strong enough to slide the movable shoes when the track is unloaded. Tower Struts

PLATE GIRDERS

77. If camber is desired it shall be provided in plate girder spans over 50 feet in length at the rate of $\frac{1}{16}$ inch per 10 feet of length. Camber

78. Where flange cover plates are used, one cover plate of the top flange shall extend the whole length of the girder. Top Flange Cover

79. There shall be web stiffeners, generally in pairs, over bearings, and at points of concentrated loading. Other web stiffeners shall be used if the width of the unsupported web between flange angles is greater than 60 times its thickness. The distance between stiffeners shall not exceed Web Stiffeners

(a) 6 feet,
(b) the width of the unsupported web,
(c) the value of d in the following formula:

$$d = \frac{t}{40}(12{,}000 - s),$$

Where d = clear distance between stiffeners of flange angles.
t = thickness of web.
s = shear per square inch.

The stiffeners at the ends and at points of concentrated loading shall be proportioned by the formula of paragraph 16, by assuming the effective length of column equal to one-half the depth of the girder. End stiffeners and those under concentrated loading shall be on fillers. Their outstanding legs

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

shall be as wide as the flange angles will allow and shall fit tightly against them. Intermediate stiffeners may be crimped or on fillers and their outstanding legs shall be not less than 2 inches plus one-thirtieth of the depth of the girder.

Stays for Top Flanges

80. Top flanges of through plate girders shall be stayed by knee braces or gusset plates at every floor beam, or in solid floor bridges at distances not exceeding 12 feet.

TRUSSES

Camber

81. Truss spans shall be given a camber by so proportioning the length of the members that the tops of the stringers will be in a straight line when the bridge is fully loaded.

Rigid Members

82. Hip verticals and members performing similar functions and the two end panels of the bottom chords of single track pin-connected trusses shall be rigid.

Eye-Bars

83. The eye-bars composing a member shall be so arranged that adjacent bars will not be in contact. The bars shall be as nearly parallel to the axis of the truss as possible, the maximum inclination of any bar being one inch in 16 feet.

Pony Trusses

84. Pony trusses shall be riveted structures with double webbed chords. The web members shall be laced or otherwise effectively stiffened.

PART SECOND—MATERIALS AND WORKMANSHIP

V. MATERIAL

Steel

85. Steel shall be made by the open-hearth process.

Properties

86. The chemical and physical properties shall conform to the following limits:

Elements Considered		Structural Steel	Rivet Steel	Steel Castings
Phosphorus, max	Basic	0.04 per cent.	0.04 per cent.	0.05 per cent.
	Acid	0.06 per cent.	0.04 per cent.	0.08 per cent.
Sulphur, maximum	. . .	0.05 per cent.	0.04 per cent.	0.05 per cent.
Yield Point, Minimum Pounds per Square Inch. . .		30,000	25,000	33,000
Ultimate tensile strength: Pounds per Square Inch		Desired 60,000	Desired 50,000	Not less than 65,000
Elong., min. %, in 8 in. Fig. 1		$\frac{1,500,000^*}{\text{Ult. tensile strength}}$	$\frac{1,500,000}{\text{Ult. tensile strength}}$	15 per cent.
Elong., min. %, in 2 in. Fig. 2		22		
Character of Fracture. . . .		Silky	Silky	Silky or fine granular
Cold Bends without Fracture		180° flat†	180° flat‡	90° d = 3t

*See paragraph 89. †See paragraphs 97, 98 and 99. ‡See paragraph 100.

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

87. In order that the ultimate strength of full-sized annealed eye-bars may meet the requirements of paragraph 163, the ultimate strength in test specimens may be determined by the manufacturers. The tests other than those for ultimate strength shall conform to the above requirements.

Allowable Variations

88. If the ultimate strength varies more than 4000 pounds from that desired, a retest shall be made on the same gauge, which, to be acceptable, shall be within 5000 pounds of the desired ultimate.

Chemical Analyses

89. Chemical determinations of the percentages of carbon, phosphorus, sulphur and manganese shall be made by the manufacturer from a test ingot taken at the time of the pouring of each melt of steel. A copy of each analysis shall be furnished to the Engineer or his inspector. Check analyses shall be made from finished material, if called for by the purchaser, in which case an excess of 25 per cent. above the limits specified will be permitted.

Specimens

90. Plate, shape and bar specimens for tensile and bending tests shall be made by cutting coupons from the finished product. The test specimens shall have both faces rolled and both edges milled either parallel or to the form shown by Fig. 1; or the specimens may be turned to a diameter of ¾ nch for a length of at least 9 inches, with enlarged ends.

91. Test specimens of rivet steel shall be cut full size from he rods as rolled.

92. Pin and roller specimens shall be cut from the finished ar, in such manner that the center of the specimen will be ne inch from the surface of the bar. The specimen for tensile est shall be turned to the form shown by Fig. 2. The specien for bending test shall be one inch by ½ inch in section.

93. The number of tests of steel castings shall depend on the haracter and importance of the castings. Specimens shall e cut cold from coupons molded and cast on some portion of ne or more castings from each melt or from the sink heads, the heads are of sufficient size. The coupon or sink head,

so used, shall be annealed with the casting before it is cut off. Test specimens shall be of the form prescribed for pins and rollers.

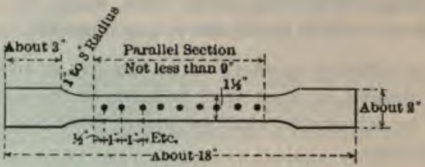


FIG. 1.

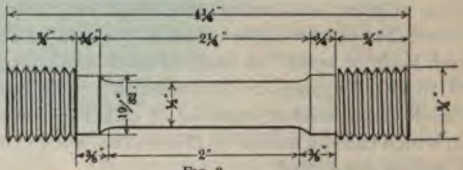


FIG. 2.

93. (*a*) The yield point shall be determined by the drop of beam of the testing machine. The beam shall be kept balancing between the upper and lower cross-pieces for some time preceding the drop. The speed of the machine shall be such that the beam may be kept balanced and, except for the initial tightening of the specimen in the grips, shall not exceed ½-inch per minute for the standard form of specimen for plates, bars and shapes, and shall not exceed ⅛-inch per minute for the standard form of specimen for pins, rollers and steel castings. The speed after the yield point shall not exceed 6 inches per minute, and the beam shall be kept at balance when the ultimate strength is attained.

Specimens of Rolled Steel

94. Rolled steel shall be tested in the condition in which it comes from the rolls.

Number of Tests

95. At least one tensile and one bending test shall be made from each melt of steel as rolled. In case steel differing ⅜ inch or more in thickness is rolled from one melt, tests shall be made from the thickest and the thinnest material rolled.

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

Modification in Elongation

leduction of 1 per cent. will be allowed from the speci-
entage of elongation, for each ⅛-inch in thickness
inch.

Bending Tests

nding tests may be made by pressure or by blows.
iapes and bars less than one inch thick shall bend
for in paragraph 86.

Thick Material

ll-sized material for eye-bars and other steel one inch
over, tested in the same condition as when rolled,
l cold 180 degrees around a pin, the diameter of which
o twice the thickness of the bar, without fracture on
le of the bend.

Bending Angles

gles ¾ inch and less in thickness shall open flat, and
inch and less in thickness shall bend shut, cold,
ws of a hammer, without sign of fracture. This test
iade only when required by the inspector.

Nicked Bends

ivet steel, when nicked and bent around a bar of the
neter as the rivet rod, shall give a gradual break and
y uniform fracture.

Finish

inished material shall be free from injurious seams,
cks, defective edges and other defects, and have a
iniform and workmanlike finish. Plates 36 inches
and under shall have rolled edges.

Melt Numbers

very finished piece of steel shall have the melt num-
he name of the manufacturer stamped or rolled upon
for pins and rollers shall be stamped on the end.
l lacing steel and other small parts may be bundled
above marks on an attached metal tag.

Defective Material

laterial which develops weak spots, brittleness, cracks
imperfections, or is found to have injurious defects,
jected at the shop and shall be replaced by the manu-
it his own cost.

Variation in Weight

variation in cross-section or weight of any piece of
nore than 2½ per cent. from that specified will be
cause for rejection, except that sheared plates shall
t to the following permissible variations, which shall
single plates, when ordered to weight:

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

105. Plates weighing 12½ pounds or more per square foot.

(*a*) Up to 100 inches wide, 2½ per cent. more or less than the nominal weight.

(*b*) One hundred inches wide and over, 5 per cent. more or less than the nominal weight.

106. Plates weighing less than 12½ pounds per square foot.

(*a*) Up to 75 inches wide, 2½ per cent. more or less than the nominal weight.

(*b*) Seventy-five inches and up to 100 inches wide, 5 per cent. more or 3 per cent. less than the nominal weight.

(*c*) One hundred inches wide and over, 10 per cent. more or 3 per cent. less than the nominal weight.

107. Plates when ordered to gauge will be accepted if they measure not more than 0.01 inch less than the ordered thickness.

108. An excess over the nominal weight, corresponding to the dimensions on the order, will be allowed for each plate, if not more than that shown in the following table, one cubic inch of rolled steel being assumed to weigh 0.2833 pound.

Thickness Ordered	Nominal Weights	Width of Plate			
		Up to 75″	75″ and up to 100″	100″ and up to 115″	Over 115″
¼ inch	10.20 lbs.	10 per cent.	14 per cent.	18 per cent.	....
5/16 "	12.75 "	8 "	12 "	16 "	....
⅜ "	15.30 "	7 "	10 "	13 "	17 per cent.
7/16 "	17.85 "	6 "	8 "	10 "	13 "
½ "	20.40 "	5 "	7 "	9 "	12 "
9/16 "	22.95 "	4½ "	6½ "	8½ "	11 "
⅝ "	25.50 "	4 "	6 "	8 "	10 "
Over ⅝ "	....	3½ "	5 "	6½ "	9 "

Cast-Iron 109. Castings shall be made of tough gray iron, with sulphur not over 0.10 per cent., except where chilled iron is specified. They shall be true to pattern, out of wind and free from flaws xcessive shrinkage. If tests are required, they shall be on the "Arbitration Bar" of the American Society for ıg Materials, which is a round bar 1¼ inches in diameter 5 inches long. The transverse test shall be made on a span of 12 inches with the load at the middle. The ıum breaking load so applied shall be 2,900 pounds, with ·ction of at least $\frac{1}{10}$ inch before rupture.

Wrought-Iron

Wrought-iron shall be double-rolled, tough, fibrous niform in character. It shall be thoroughly welded in and free from surface defects. When tested in speci- ɔf the form of Fig. 1, or in full-sized pieces of the same , it shall show an ultimate strength of at least 50,000 s per square inch, an elongation of at least 18 per cent. in es, with fracture wholly fibrous. Specimens shall bend ɪith the fiber, through 135 degrees, without sign of frac- round a pin the diameter of which is twice the thickness piece tested. When nicked and bent, the fracture shall ıt least 90 per cent. fibrous.

VI. INSPECTION AND TESTING AT THE MILLS

Mill Orders

The purchaser shall be furnished complete copies of rders, and no material shall be rolled nor work done the purchaser has been notified where the orders have laced, so that he may arrange for the inspection.

Facilities for Inspection

The manufacturer shall furnish all facilities for inspect- d testing the weight and quality of all material at the here it is manufactured. He shall furnish a suitable machine for testing the specimens, as well as prepare ·ces for the machine, free of cost to the purchaser.

Access to Mills

The inspector representing the purchaser at the mills ıave access, at all times, to all parts of the mills where al to be inspected by him is being manufactured.

VII. WORKMANSHIP

General

All parts forming a structure shall be built in accord- ɪith approved drawings. The workmanship and finish

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

shall be equal to the best practice in modern bridge works. Material at the shops shall be kept clear and protected from the weather.

Straightening

115. Material shall be thoroughly straightened in the shop, by methods that will not injure it, before being laid off or worked in any way.

Finish

116. Shearing and chipping shall be neatly and accurately done and all portions of the work exposed to view neatly finished.

Size of Rivets

117. The size of rivets, called for on the plans, shall be the actual size of the rivet before heating.

Rivet Holes

118. If general reaming is not required, the diameter of the punch shall be not more than $\frac{1}{16}$ inch greater than the diameter of the rivet; nor the diameter of the die more than $\frac{1}{8}$ inch greater than the diameter of the punch. Material more than $\frac{3}{4}$ inch thick shall be sub-punched and reamed or drilled from the solid.

Punching

119. Punching shall be accurately done. There shall be no drifting to enlarge unmatched holes. If the holes must be enlarged to admit the rivet, they shall be reamed. Poor matching of holes will be cause for rejection.

Reaming

120. Where sub-punching and reaming are required, the diameter of the punch used shall be not less than $\frac{3}{16}$ inch smaller than the nominal diameter of the rivet. The holes shall then be reamed to a diameter not more than $\frac{1}{16}$ inch greater than the nominal diameter of the rivet. (See 135.)

Reaming After Assembling

121. *[If general reaming is required it shall be done after the pieces forming one built member are assembled and so firmly bolted together that the surfaces are in close contact. If it be necessary to take the pieces apart for shipping and handling, the respective pieces reamed together shall be so marked that they may be reassembled in the same position in the final setting up. No interchange of reamed parts will be permitted.]

122. Reaming shall be done with twist drills without lubricant.

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*See Addendum, clause (d), page 534.

123. The outside burrs on reamed holes shall be removed to the extent of making a $\frac{1}{16}$ inch fillet.

Assembling

124. The parts of riveted members shall be well pinned and firmly drawn together with bolts, before riveting is commenced. Contact surfaces shall be painted. (See 152.)

Lacing Bars

125. The ends of lacing bars shall be neatly rounded, unless otherwise called for.

Web Stiffeners

126. Stiffeners shall fit neatly between the flanges of girders. Where tight fits are called for, the ends of the stiffeners shall be faced and shall be brought to a true contact bearing with the flange angles.

Splice Plate and Fillers

127. Web splice plates and fillers under stiffeners shall be cut to fit within $\frac{1}{8}$ inch of the flange angles.

Web Plates

128. Web plates of girders, which have no cover plates, shall be flush with the backs of the flange angles or project above them not more than $\frac{1}{8}$ inch, unless otherwise called for When web plates are spliced, not more than $\frac{1}{4}$ inch clearance between ends of plates will be allowed.

Floor Beams and Stringers

129. The main sections of floor beams and stringers shall be milled to exact length after riveting and the connection angles accurately set flush and true to the milled ends.* [If required by the purchaser the milling shall be done after the connection angles are riveted in place, the milling to extend over the entire face of the member]. The removal of more than $\frac{3}{32}$ inch from the thickness of connection angles will be cause for rejection.

Riveting

130. Rivets shall be uniformly heated to a light cherry red heat in a gas or oil furnace so constructed that it can be adjusted to the proper temperature. They shall be driven by pressure tools wherever possible. Pneumatic hammers shall be used in preference to hand driving.

131. Rivet heads shall be of approved shape, uniform in size, and of neat and finished appearance. They shall be central on the shank and shall grip the assembled pieces firmly. Recupping and caulking will not be allowed. Loose, burned or

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*See Addendum, clause (f), page 534.

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

otherwise defective rivets shall be cut out and replaced. In cutting out rivets, care shall be taken not to injure the adjacent metal. If necessary, they shall be drilled out.

Turned Bolts

132. Wherever bolts are used in place of rivets which transmit shear, the holes shall be reamed parallel and the bolts shall make a driving fit with the threads entirely outside of the holes. A washer not less than ¼ inch thick shall be used under nut.

Members to be Straight

133. The several pieces forming one built member shall be straight and fit closely together. Finished members shall be free from twists, bends and open joints.

Finish of Joints

134. Abutting joints shall be cut or dressed true and straight and fitted close together, especially where open to view. In compression joints, depending on contact bearing, the surfaces shall be truly faced, so as to provide even bearings after they have been perfectly aligned and riveted complete.

Field Connections

135. Holes for floor beam and stringer connections shall be sub-punched and reamed to a steel templet not less than one inch thick. †[If required, all other field connections, except those for laterals and sway bracing, shall be assembled in the shop and the unmatched holes reamed; and when so reamed the pieces shall be match-marked before being taken apart.]

Eye-Bars

136. Eye-bars shall be straight, true to size, and free from twists, folds in the neck or head, and other defects. The heads shall be made by upsetting, rolling or forging. Welding will not be allowed. The form of the heads will be determined by the dies in use at the works where the eye-bars are made, if satisfactory to the Engineer; but the manufacturer shall guarantee the bars to break in the body when tested to rupture. The thickness of the head and neck shall not vary more than $\frac{1}{16}$ inch from that specified. (See 163.)

Boring Eye-Bars

137. Before boring, each eye-bar shall be properly annealed and carefully straightened. Pin-holes shall be in the center

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†See Addendum, clause (e), page 534.

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

he bar and in the center of the heads. Bars of the gth shall be bored so accurately that, when placed pins $\frac{1}{32}$ inch smaller in diameter than the pin- be passed through the holes at both ends of the bars me time without forcing.

Pin-Holes

in-holes shall be bored true to gauges, smooth, at right angles to the axis of the member and parallel ther, unless otherwise called for. The boring shall fter the member is riveted.

he distance center to center of pin-holes shall be ithin $\frac{1}{32}$-inch, and the diameter of the holes not more inch larger than that of the pin, for pins up to 5 inch , and $\frac{1}{32}$ inch for larger pins.

Pins and Rollers

ins and rollers shall be accurately turned to gauges be straight, smooth and free from flaws.

Screw Threads

crew threads shall make tight fits in the nuts and J. S. standard, except above the diameter of 1⅜ inch, y shall be made with six threads per inch.

Annealing

teel which has been partially heated shall be properly except where used in minor details.

Steel Castings

teel castings shall be annealed and free from large or blowholes.

Welds

Velds in steel will not be allowed.

Bed Plates

xpansion bed plates shall be planed true and smooth. l plates shall be planed top and bottom. The finish- f the planing tool shall be fine and parallel with the of expansion.

Pilot Nuts

ilot and driving nuts shall be furnished for each size such numbers as may be ordered.

Field Rivets

ield rivets shall be furnished to the amount of 10 per s ten rivets, in excess of the nominal number required size.

Shipping Details

ins, nuts, bolts, rivets and other small parts shall be crated.

Weight

149. The scale weight of every piece and box shall be marked on it in plain figures.

Finished Weight

150. Payment for pound price contracts shall be by scale weight. Not over 2 per cent. of the total weight of the structure as computed from the plans will be allowed for excess weight.

VIII. SHOP PAINTING

Cleaning

*151. Steel work, before leaving the shop, shall be thoroughly cleaned and given one good coating of pure linseed oil, or such paint as may be called for, well worked into all joints and open spaces.

Contact Surfaces

152. In riveted work, the surfaces coming in contact shall each be painted before being riveted together.

Inaccessible Surfaces

153. Pieces and parts which will not be accessible for painting after erection, including tops of stringers, eye-bar heads, ends of posts and chords, etc., shall have an additional coat of paint before leaving the shop.

Condition of Surfaces

154. Painting shall be done only when the surface of the metal is perfectly dry. It shall not be done in wet or freezing weather, unless protected under cover.

Machine-Finished Surfaces

155. Machine-finished surfaces shall be coated with white lead and tallow before shipment and before being put out into the open air.

IX. INSPECTION AND TESTING AT THE SHOPS

Facilities for Inspection

156. The manufacturer shall furnish all facilities for inspecting and testing the weight of material and quality of workmanship at the shop where material is manufactured. He shall furnish a suitable testing machine for testing full-sized members, if required.

Starting Work

157. The purchaser shall be notified well in advance of the start of the work in the shop, in order that he may have a representative on hand to inspect material and workmanship.

Access to Shop

158. The inspector shall have access, at all times, to all parts of the shop where material to be inspected by him is being manufactured.

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*See Addendum clause (b), page 534.

SPECIFICATIONS FOR STEEL RAILWAY BRIDGES.—*Continued*

Accepting Material

The inspector shall stamp each piece accepted with a mark. Any piece not so marked may be rejected at ie and at any stage of the work. If the inspector an oversight or otherwise, has accepted material or iich is defective or contrary to the specifications, this l, no matter in what stage of completion, may be rey the purchaser.

Shop Plans

The purchaser shall be furnished complete shop plans.

Shipping Invoices

Complete copies of all shipping invoices shall be furto the purchaser with each shipment. Shipping shall show the scale weights of individual pieces.

X. FULL-SIZED TESTS

Eye-Bar Tests

Full-sized tests of eye-bars and similar members, to ie workmanship, shall be made at the manufacturer's , and the members so tested shall be paid for by the er at contract price, if the tests are satisfactory. If s are not satisfactory, the members represented by ll be rejected.

In eye-bar tests, the minimum ultimate strength shall 0 pounds per square inch. The elongation in 10 feet, g the fracture, shall be not less than 10 per cent. ıll generally break in the body and the fracture shall or fine granular. The elastic limit as indicated by p of the mercury shall be recorded. Should a bar the head and develop the specified elongation, ultiength and character of fracture, it shall not be cause tion, provided not more than one-third of the total of bars tested break in the head (see 136).

ADDENDUM TO GENERAL SPECIFICATIONS FOR STEEL RAILWAY BRIDGES

POINTS TO BE SPECIFICALLY DETERMINED BY BUYERS WHEN SOLICITING PROPOSALS FOR STEEL RAILWAY BRIDGES

When general detail drawings are not furnished for the use of bidders specific answers should be given to questions a, b, and c, below.

Specific answers should also be given to questions d, e and f, if the class of work described in any of the paragraphs there referred to is desired. If these features are not specifically demanded, the unbracketed paragraphs will be construed to define the kind of work desired.

(a) What class of live load shall be used? (Pars. 7 and 8.)

(b) Shall linseed oil or paint be used? If paint, what kind? (Par. 151.)

(c) Shall contractor furnish floor bolts?

*(d) Shall general reaming be done? (Par. 121.)

(e) Shall field connections be assembled at the shops? (Par. 135.)

*(f) Shall floor connection angles be milled after riveting? (Par. 129.)

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*NOTE.—The practice adopted and followed by a large number of railway engineers using the American Railway Engineering Association Specifications is as follows:

(d) Reaming of material under $\frac{5}{8}$" in thickness is not required.

(f) Floor connection angles are to be set to exact position so that milling of these angles will not be necessary, as this would reduce the thickness of the connection angles.

This note is not a portion of the American Railway Engineering Association Specifications.

RECOMMENDATION BY THE AMERICAN RAILWAY ENGINEERING ASSOCIATION

COMMITTEE XV.

IRON AND STEEL STRUCTURES

CONTRACTING FOR STEEL RAILWAY BRIDGES

It is recommended that railway companies

(1) Furnish general detailed plans and specifications of structural work to bidders, complete enough to show the exact character of the work. If such plans cannot be furnished, the alternative should be full specifications, accompanied by outline plans and complete information concerning the work.

(2) Invite bids on a pound price basis. If desired, alternate bids may be asked for the work, f. o. b. cars, and for the work erected. A lump sum bid is inadmissible unless general detailed plans and specifications are furnished.

(3) Invite bids for as large groups of bridges as can be defined consistently with the first recommendation. When necessary to anticipate future requirements, the railway company need not submit designs if the nature of the work s known to the bidder by reason of similar work previously performed by him for the railway, or if designs of similar structures are submitted to the bidders.

(4) Erect bridges with their own forces on lines where traffic is to be maintained. On small railways where suitably organized and equipped forces for such work may not be justified, the large bridges, and in some cases all bridges, may be erected by contract.

(5) Furnish and lay the floor timber in all cases.

STANDARD SPECIFICATIONS FOR STRUCTURAL STEEL FOR BRIDGES

SERIAL DESIGNATION: A7-16

ADOPTED 1901; REVISED 1905, 1909, 1913, 1914, 1915, 1916 BY THE
AMERICAN SOCIETY FOR TESTING MATERIALS
AFFILIATED WITH THE
INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS

(For the Metric equivalents of the dimensions and weights given in these specifications, refer to the tables on Pages 14 to 28.)

Steel Castings

1. The Standard Specifications for Steel Castings (Serial Designation A27) adopted by the American Society for Testing Materials shall govern the purchase of steel castings for bridges. Unless otherwise specified, Class B castings, medium grade, shall be used.

I. MANUFACTURE

Process

2. The steel shall be made by the Open Hearth process.

II. CHEMICAL PROPERTIES AND TESTS.

Chemical Composition

3. The steel shall conform to the following requirements as to chemical composition:

		Structural Steel	Rivet Steel
Phosphorus	Acid	Not over 0.06%	Not over 0.04 %
	Basic	Not over 0.04%	Not over 0.04 %
Sulphur		Not over 0.05%	Not over 0.045%

Ladle Analyses

4. An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of carbon, manganese, phosphorus and sulphur. This analysis shall be made from a test ingot taken during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, and shall conform to the requirements specified in Section 3.

Check Analyses

5. Analyses may be made by the purchaser from finished material representing each melt. The phosphorus and sulphur content thus determined shall not exceed that specified in Section 3 by more than 25 per cent.

SPECIFICATIONS FOR STRUCTURAL STEEL FOR BRIDGES.—*Continued*

III. PHYSICAL PROPERTIES AND TESTS

Tension Tests

6. (*a*) **The material shall conform to the following re- uirements as to tensile properties:**

Properties Considered	Structural Steel	Rivet Steel
nsile strength, lbs. per sq. in. . . .	55 000–65 000[a]	46 000–56 000
ld point, min., lb. per sq. in. . . .	0.5 tens. str.	0.5 tens. str.
ngation in 8-in., min., per cent. .	$\frac{1\,500\,000^{b}}{\text{Tens. str.}}$	$\frac{1\,500\,000}{\text{Tens. str.}}$
ngation in 2-in., min., per cent. .	22	. . . .

See Paragraph (*b*).
See Section 7.

(*b*) In order to meet the required minimum tensile ength of full-sized annealed eyebars, the purchaser may termine the tensile strength to be obtained in specimen ts; the range shall not exceed 14,000 pounds per square h, and the maximum shall not exceed 74,000 pounds per are inch. The material shall conform to the requirements to physical properties other than that of tensile strength, cified in Sections 6, 7 and 8 (*b*).

(*c*) The yield point shall be determined by the drop of beam of the testing machine.

Modifications in Elongation

7. (*a*) For structural steel over ¾ inch in thickness, a luction of 1 from the percentage of elongation in 8 inches cified in Section 6 (*a*) shall be made for each increase of inch in thickness above ¾ inch, to a minimum of 18 per t.

(*b*) For structural steel under $\frac{5}{16}$ inch in thickness, a uction of 2.5 from the percentage of elongation in 8 inches cified in Section 6 (*a*) shall be made for each decrease of $\frac{1}{16}$ 1 in thickness below $\frac{5}{16}$ inch.

Bend Tests

8. (*a*) The test specimen for plates, shapes, and bars, ept as specified in Paragraphs (*b*), (*c*) and (*d*), shall bend 1 through 180 degrees without cracking on the outside of bent portion, as follows: For material ¾ inch or under in kness, flat on itself; for material over ¾ inch to and in- ling 1¼ inches in thickness, around a pin the diameter of ch is equal to the thickness of the specimen; and for ma- al over 1¼ inches in thickness, around a pin the diameter hich is equal to twice the thickness of the specimen.

SPECIFICATIONS FOR STRUCTURAL STEEL FOR BRIDGES.—*Continued*

(*b*) The test specimen for eyebar flats shall bend cold through 180 degrees without cracking on the outside of the bent portion as follows: For material ¾-inch or under in thickness, around a pin the diameter of which is equal to the thickness of the specimen; for material over ¾-inch, to and including 1¼ inches in thickness, around a pin the diameter of which is equal to twice the thickness of the specimen; and for material over 1¼ inches in thickness, around a pin the diameter of which is equal to three times the thickness of the specimen.

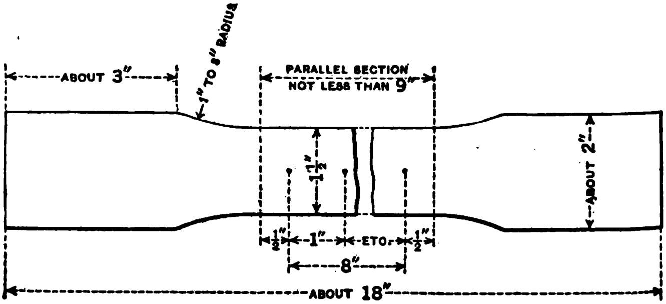


Figure 1

(*c*) The test specimen for pins, rollers and other bars, when prepared as specified in Section 9 (*e*), shall bend cold through 180 degrees around a 1-inch pin without cracking on the outside of the bent portion.

(*d*) The test specimen for rivet steel shall bend cold through 180 degrees flat on itself without cracking on the outside of the bent portion.

Test Specimens

9. (*a*) Tension and bend test specimens shall be taken from rolled steel in the condition in which it comes from the rolls, except as specified in Paragraph (*b*).

(*b*) Tension and bend test specimens for pins and rollers shall be taken from the finished bars, after annealing when annealing is specified.

SPECIFICATIONS FOR STRUCTURAL STEEL FOR BRIDGES.—*Continued*

(*c*) Tension and bend test specimens for plates, shapes nd bars, except as specified in Paragraphs (*d*), (*e*) and (*f*), iall be of the full thickness of material as rolled. They may e machined to the form and dimensions shown in Fig. 1, or ith both edges parallel; except that bend test specimens for ebar flats may have three rolled sides.

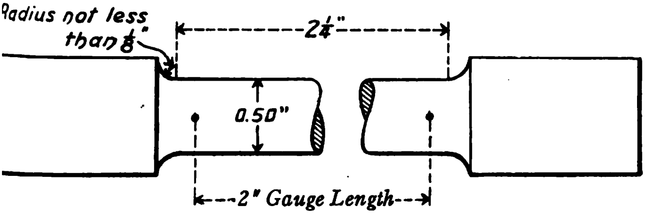


Figure 2

NOTE.—The gauge length, parallel portions and fillets shall be shown as the ends may be of any form which will fit the holders of the testing hine.

(*d*) Tension and bend test specimens for plates, and sion test specimens for eyebar flats, over 1½ inches in kness may be machined to a thickness or diameter of at t ¾-inch for a length of at least 9 inches.

(*e*) Tension test specimens for pins, rollers and bars cept eyebar flats) over 1½ inches in thickness or diameter y conform to the dimensions shown in Figure 2. In this e the ends shall be of a form to fit the holders of the testing chine in such a way that the load shall be axial. Bend specimens may be 1 inch by ½ inch in section. The s of the specimen shall be located at any point midway between the center and surface and shall be parallel to the axis of bar.

(*f*) Tension and bend test specimens for rivet steel shall f the full-size section of bars as rolled.

Number of Tests

0. (*a*) One tension and one bend test shall be made from h melt; except that if material from one melt differs ⅜-inch

or more in thickness, one tension and one bend test shall made from both the thickest and the thinnest material rol

(*b*) If any test specimen shows defective machining develops flaws, it may be discarded and another specimen s stituted.

(*c*) If the percentage of elongation of any tension specimen is less than that specified in Section 6 (c) and a part of the fracture is more than ¾-inch from the center the gauge length of a 2-inch specimen or is outside the mid third of the gauge length of an 8-inch specimen, as indica by scribe scratches marked on the specimen before testing retest shall be allowed.

IV. PERMISSIBLE VARIATIONS IN WEIGHT AND THICKNESS

Permissible Variations

11. The cross-section or weight of each piece of steel sh not vary more than 2.5 per cent. from that specified: exc in the case of sheared plates, which shall be covered by t following permissible variations. One cubic inch of roll steel is assumed to weigh 0.2833 pounds.

(*a*) *When Ordered to Weight per Square Foot:* T weight of each lot[1] in each shipment shall not vary from weight ordered more than the amount given in Table I.

(*b*) *When Ordered to Thickness:* The thickness of e plate shall not vary more than 0.01 inch under that order

The overweight of each lot[2] in each shipment shall not ceed the amount given in Table II.

---

[1] The term "lot" applied to Table I means all of the plates of each gr width and group weight.

[2] The term "lot" applied to Table II means all of the plates of each gr width and group thickness.

SPECIFICATIONS FOR STRUCTURAL STEEL FOR BRIDGES.—*Continued*

ABLE I.—PERMISSIBLE VARIATIONS OF PLATES ORDERED TO WEIGHT

DERED EIGHT, NDS PER Q. FT.	PERMISSIBLE VARIATIONS IN AVERAGE WEIGHTS PER SQUARE FOOT OF PLATES FOR WIDTHS GIVEN, EXPRESSED IN PERCENTAGES OF ORDERED WEIGHTS																		ORDERED WEIGHT, POUNDS PER SQ. FT.
	Under 48 in.		48 to 60 in. excl.		60 to 72 in. excl.		72 to 84 in. excl.		84 to 96 in. excl.		96 to 108 in. excl.		108 to 120 in. excl.		120 to 132 in. excl.		132 in. or over		
	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	
5	5	3	5.5	3	6	3	7	3	...	...	...	...	...	...	...	...	...	...	Under 5
7.5 excl.	4.5	3	5	3	5.5	3	6	3	...	...	...	...	...	...	...	...	...	...	5 to 7.5 excl.
10 excl.	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	...	...	...	...	7.5 to 10 excl.
12.5 excl.	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	9	3	10 to 12.5 excl.
15 excl.	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	12.5 to 15 excl.
17.5 excl.	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	15 to 17.5 excl.
20 excl.	2.5	2	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	17.5 to 20 excl.
25 excl.	2	2	2.5	2	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	20 to 25 excl.
30 excl.	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	4.5	3	5	3	25 to 30 excl.
40 excl.	2	2	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	4.5	3	30 to 40 excl.
ver	2	2	2	2	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	40 or over

.—The weight per square foot of individual plates shall not vary from the ordered by more than 1⅓ times the amount given in this table.

TABLE II.—PERMISSIBLE OVERWEIGHTS OF PLATES ORDERED TO THICKNESS

ERED KNESS, HES	PERMISSIBLE EXCESS IN AVERAGE WEIGHTS PER SQUARE FOOT OF PLATES FOR WIDTHS GIVEN, EXPRESSED IN PERCENTAGES OF NOMINAL WEIGHTS									ORDERED THICKNESS, INCHES
	Under 48 in.	48 to 60 in., excl.	o0 to 72 in., excl.	72 to 84 in., excl.	84 to 96 in., excl.	96 to 108 in., excl.	108 to 120 in., excl.	120 to 132 in., excl.	132 in. or over	
⅛	9	10	12	14	....	....	..	..	..	Under ⅛
$\frac{3}{16}$ excl.	8	9	10	12	....	....	..	..	..	⅛ to $\frac{3}{16}$ excl.
/4 excl.	7	8	9	10	12	....	..	..	..	$\frac{3}{16}$ to ¼ excl.
$\frac{5}{16}$ excl.	6	7	8	9	10	12	14	16	19	¼ to $\frac{5}{16}$ excl.
/8 excl.	5	6	7	8	9	10	12	14	17	$\frac{5}{16}$ to ⅜ excl.
$\frac{7}{16}$ excl.	4.5	5	6	7	8	9	10	12	15	⅜ to $\frac{7}{16}$ excl.
/2 excl.	4	4.5	5	6	7	8	9	10	13	$\frac{7}{16}$ to ½ excl.
/8 excl.	3.5	4	4.5	5	6	7	8	9	11	½ to ⅝ excl.
/4 excl.	3	3.5	4	4.5	5	6	7	8	9	⅝ to ¾ excl.
excl.	2.5	3	3.5	4	4.5	5	6	7	8	¾ to 1 excl.
ver	2.5	2.5	3	3.5	4	4.5	5	6	7	1 or over

SPECIFICATIONS FOR STRUCTURAL STEEL FOR BRIDGES.—*Continued*

V. FINISH

Finish

12. The finished material shall be free from injurious defects and shall have a workmanlike finish.

VI. MARKING

Marking

13. The name or brand of the manufacturer and the melt number shall be legibly stamped or rolled on all finished material, except that rivet and lattice bars and other small sections shall, when loaded for shipment, be properly separated and marked for identification. The identification marks shall be legibly stamped on the end of each pin and roller. The melt number shall be legibly marked, by stamping if practicable, on each test specimen.

VII. INSPECTION AND REJECTION

Inspection

14. The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection

15. (*a*) Unless otherwise specified, any rejection based on tests made in accordance with Section 5 shall be reported within five working days from the receipt of samples.

(*b*) Material which shows injurious defects subsequent to its acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

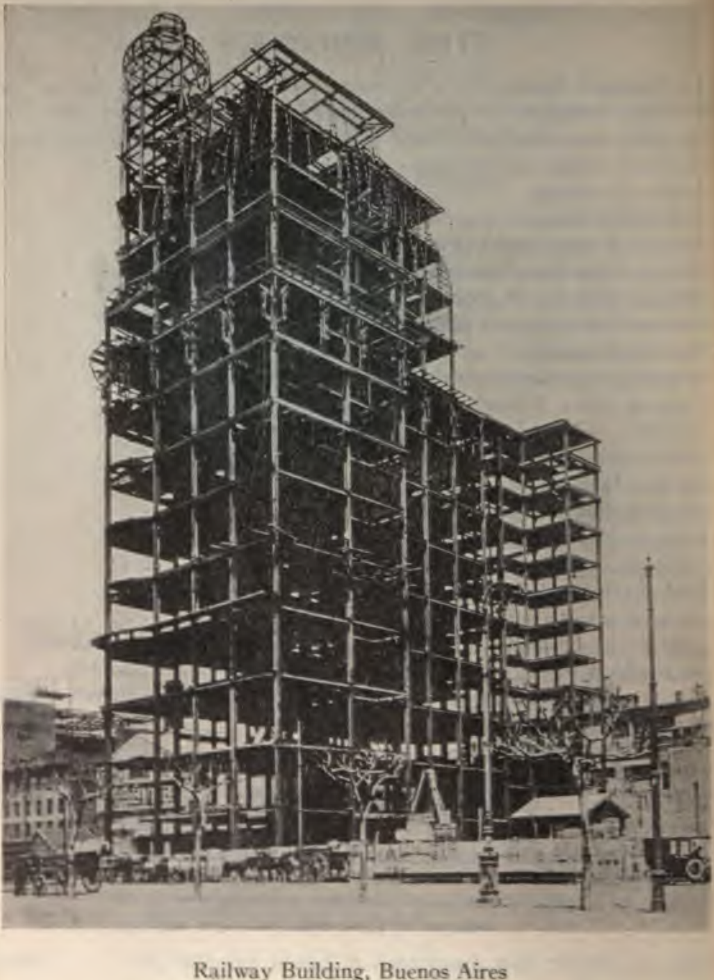
Rehearing

16. Samples tested in accordance with Section 5, which represent rejected material, shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

STRUCTURAL STEEL WORK.—*Continued*

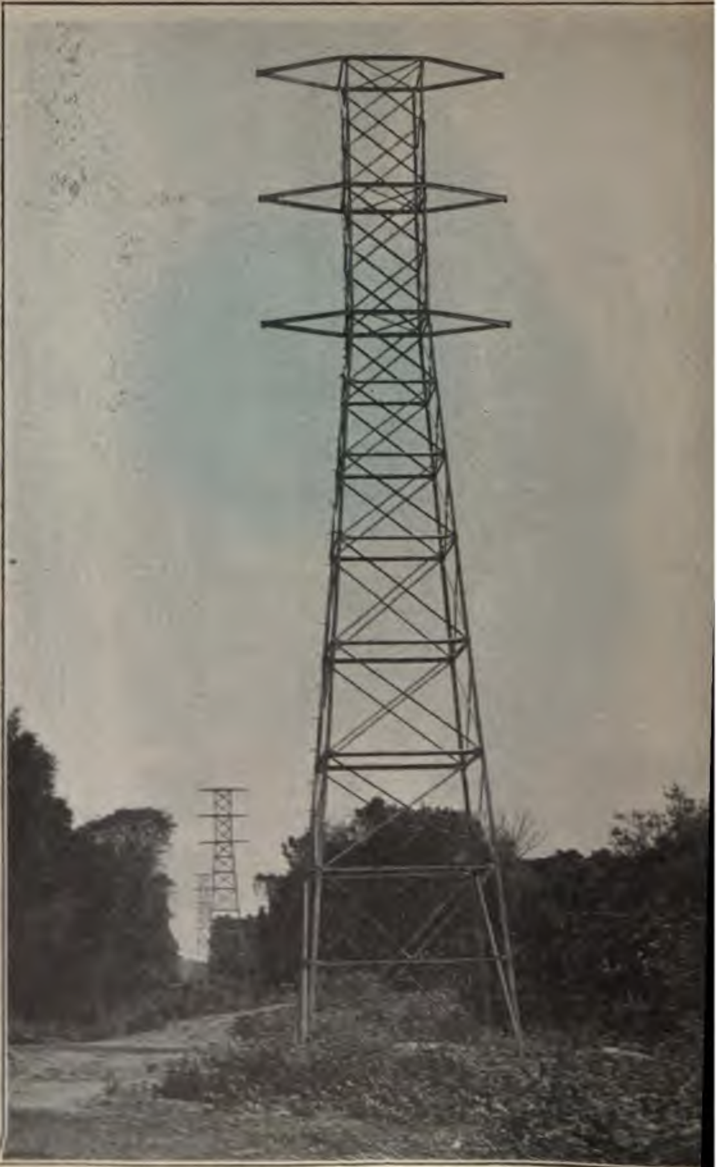
STEEL BUILDINGS

Standard Specifications for Structural Work of Buildings see pages
560. Requests for proposals should be accompanied by a statement
under mentioned particulars, which are necessary to enable us to prop-
repare designs and estimates:
gth of building.
th of building.
nber of aisles, and width of same.
ance from top of masonry to under side of roof trusses.
ance from top of masonry to top of crane rail.
ance from center to center of crane rails.
acity of crane.
ane for hand or electric power?
e clearance, if fixed.
uilding subject to snow loads and high winds?
nber and kind of floors.
ance from top of masonry to top of floor.
ance from top of floor to top of next floor.
d of roof covering.
purlins to be wood or steel?
d of sides and ends.
louvres to be furnished by us?
doors to be furnished by us? If so, state size, number and kind.
windows to be furnished by us? If so, state size and number.
gutters and conductors to be furnished by us? If so, state size of gutters
ductors.
monitor required?
ventilators required?
usses carry loads other than roof loads, state location and weight.
skylights to be furnished by us? If so, state length and width.
field connections for structural work to be rivets or bolts?

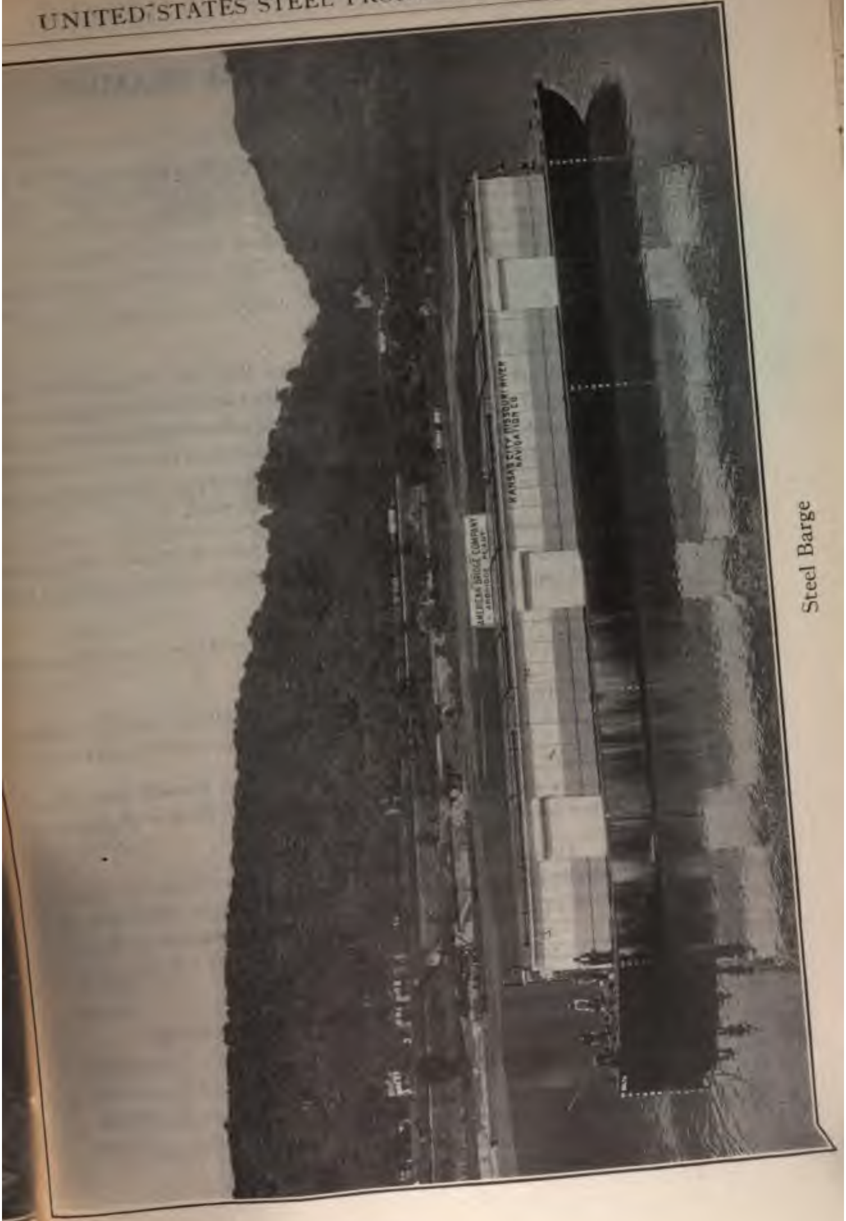


Railway Building, Buenos Aires

Balboa Galvanizing Building, Panama Canal



Steel Transmission Tower


AMERICAN BRIDGE COMPANY
AMBRIDGE PLANT
KANSAS CITY MISSOURI RIVER
NAVIGATION CO

Steel Barge

SPECIFICATIONS FOR STEEL FRAMED STRUCTURES

DESIGN, DETAILS OF CONSTRUCTION AND WORKMANSHIP
AMERICAN BRIDGE COMPANY STANDARD

ADOPTED 1912

DESIGN

1. *Loads.* The steel frame of all structures shall be designed so as to safely support the dead and live loads. The dead load shall consist of the weight of all permanent construction and fixtures, such as walls, floors, roofs, interior partitions, and fixed or permanent appliances. The live load shall consist of movable loads on floors, loads due to machinery or other appliances, and the exterior loads due to snow on the roof and to wind.

2. For structures carrying traveling machinery, such as cranes, conveyors, etc., 25% shall be added to the stresses resulting from such live load, to provide for the effect of impact and vibrations.

3. The wind pressure shall be assumed acting horizontally in any direction as follows:—

First: For finished structures—A pressure of 20 pounds per square foot on the sides and ends of buildings and on the vertical projection of roof surfaces, or

Second: In process of construction—A pressure of 30 pounds per square foot on vertical surfaces and the vertical projection of inclined surfaces of all exposed metal or other frame work.

4. *Unit Stresses.* All parts of structures shall be proportioned so that the sum of the dead and live loads, together with the impact, if any, shall not cause the stresses to exceed the following amounts in pounds per square inch:

Tension, net section, rolled steel	16000
Direct compression, rolled steel and steel castings	16000
Bending, on extreme fibers of rolled shapes, built sections, girders, and steel castings	16000
Bending on extreme fibers of pins	24000
Shear on shop rivets and pins	12000
Shear on bolts and field rivets	10000

SPECIFICATIONS FOR STEEL FRAMED STRUCTURES.—*Continued*

Shear—average—on webs of plate girders and rolled beams, gross section..10000
Bearing pressure on shop rivets and pins..................24000
Bearing on bolts and field rivets..........................20000

The pressure per linear inch on expansion rollers shall not exceed 600 times he diameter of rollers in inches.

Axial compression of gross sections of columns, for ratio of $\frac{l}{r}$ up to 120.......................................$19000-100\frac{l}{r}$
with a maximum of..13000
where l = effective length of members in inches,
r = corresponding radius of gyration of section in inches.

For ratios of $\frac{l}{r}$ up to 120, and for greater ratios up to 200, use the amounts given in the following table. For intermediate ratios, use proportional amounts.

Ratio	Amount	Ratio	Amount
60	13000	130	6500
70	12000	140	6000
80	11000	150	5500
90	10000	160	5000
100	9000	170	4500
110	8000	180	4000
120	7000	190	3500

5. For bracing and combined stresses due to wind and other loading, the permissible working stresses may be increased 25%—provided the section thus found is not less than that required by the dead and live loads alone.

PROPORTION OF PARTS

6. *General.* The effective or unsupported length of main compression members shall not exceed 120 times, and for secondary members 200 times, the east radius of gyration.

7. In proportioning columns, provision must be made for eccentric loading.

SPECIFICATIONS FOR STEEL FRAMED STRUCTURES.—*Continued*

8. In proportioning tension members, net section must be used. Riv holes deducted must be taken $\frac{1}{8}$ inch larger than the nominal size of rivets.

9. Members subject to the action of both axial and bending stresses sh be proportioned so that the greatest fiber stress will not exceed the allow limits in that member.

10. Members subject to alternate stresses of tension and compression sh be proportioned for the stress giving the largest section, but their connectio shall be proportioned for the sum of the stresses.

11. *Girders.* Rolled I-beams and channels, and built-up members used beams and girders shall be proportioned by their moments of inertia of the gross sections.

12. Plate girder webs shall have a thickness not less than $\frac{1}{160}$ of the un supported distance between flange angles. The webs shall have stiffener generally in pairs, over bearings, at points of concentrated loading, and a other points where the thickness of the web is less than $\frac{1}{60}$ of the unsupporte distance between flange angles, generally not farther apart than the depth o the web plate, with a maximum limit of six (6) feet.

13. The lateral unsupported length of beams and girders shall not exceed 40 times the width of the compression flange. When the unsupported length (l) exceeds 10 times the width (b) of the compression flange, the stress pe square inch in the compression flange shall not exceed $19000—300\frac{l}{b}$.

DETAILS OF STEEL CONSTRUCTION

14. *General.* Adjustable members in any part of structures shall prefer ably be avoided.

15. Sections shall preferably be made symmetrical.

16. No connection, except lattice bars, shall have less than two rivets.

17. Trusses shall preferably be riveted structures. Heavy trusses of lon span, where the riveted field connections would become unwieldy, or for othe good reasons, may be designed as pin-connected structures.

18. Abutting joints in compression members faced for bearing shall b spliced sufficiently to hold the connecting members accurately in place. A other joints in riveted work, whether in tension or compression, shall be full spliced.

19. Lateral, longitudinal and transverse bracing in all structures sha preferably be composed of rigid members, and shall be designed to be sufficie

SPECIFICATIONS FOR STEEL FRAMED STRUCTURES.—*Continued*

ithstand wind and other lateral forces when building is in process of erec-
as well as after completion.

). *Girders.* When two or more rolled beams are used to form a girder,
shall be connected by bolts and separators at intervals of not more than
t. All beams having a depth of 12 inches and more shall have at least two
to each separator.

. The flange plates of all girders shall be limited in width, so as not to
ıd more than 6 inches beyond the outer line of rivets connecting them to
ngles, or eight times the thickness of the thinnest plate.

. Web stiffeners shall be in pairs, and shall have a close bearing against
lange angles. Those over the end bearing or forming the connection
een girder and column shall be on fillers. Intermediate stiffeners may be
lers or crimped over the flange angles.

. Web plates of girders must be spliced at all points by a plate on each
of the web, capable of transmitting the full stress through splice rivets.

. *Riveting.* The minimum distance between centers of rivet holes shall
ıree diameters of the rivet; but the distance shall preferably be not less
3 inches for ⅞ inch rivets, 2½ inches for ¾ inch rivets, 2 inches for
ch rivets, and 1¾ inches for ½ inch rivets. The maximum pitch in the
of the stress for members composed of plates and shapes will be 6 inches
/8 inch rivets, 6 inches for ¾ inch rivets, 4½ inches for ⅝ inch rivets and
hes for ½ inch rivets.

. For angles in built sections with two gauge lines, with rivets staggered,
naximum pitch in each line shall be twice as great as given above. Where
or more plates are in contact, rivets not more than 12 inches apart in either
tion shall be used to hold the plates together.

. The minimum distance from the center of any rivet hole to a sheared
shall be 1½ inches for ⅞ inch rivets, 1¼ inches for ¾ inch rivets, 1⅛
s for ⅝ inch rivets and 1 inch for ½ inch rivets; and to a rolled edge, 1¼,
1, and ⅞ inches, respectively.

. The maximum distance from any edge shall be eight times the thickness
e plate.

. The pitch of rivets at the ends of built compression members shall not
d four diameters of the rivets for a length equal to one and one-half
s the maximum width of the member.

. *Latticing.* The open sides of compression members shall be provided
lattice bars, having tie plates at each end and at intermediate points
e the lattice is interrupted. The tie plates shall be as near the ends as

practicable. In main members carrying calculated stresses, the end tie plates shall have a length not less than the distance between the lines of rivets connecting them to the flanges, and intermediate ones not less than half this distance. Their thickness shall not be less than one-fiftieth of the same distance.

30. The latticing of compression members shall be proportioned to resist a shearing stress equal to 2% of the direct stress. The minimum thickness of lattice bars shall be for single lattice, one-fortieth, and for double lattice, one-sixtieth of the distance between the end rivets. Their minimum width shall be as follows:

For 15 inch channels, or built sections with 3½ and 4 inch angles	2½ inches	(⅞ inch rivets).
For 12, 10 and 8 inch channels, or built sections with 3 inch angles	2¼ inches	(¾ inch rivets).
For 8 and 7 inch channels, or built sections with 2½ inch angles	2 inches	(⅝ inch rivets).
For 6 and 5 inch channels, or built sections with 2 inch angles	1¾ inches	(½ inch rivets).

31. The inclination of lattice bars with the axis of the member shall generally be not less than 45 degrees. When the distance between the rivet lines in the flanges is more than 15 inches, if a single rivet bar is used, the lattice shall be double.

32. The pitch of lattice connections, along the flange, divided by the least radius of gyration of the member between connections, shall be less than the corresponding ratio of the member as a whole.

33. *Pins.* Pin holes shall be reinforced by plates where necessary. At least one plate shall be as wide as the projecting flanges will allow; where angles are used, this plate shall be on the same side as the angles. The plates shall contain sufficient rivets to distribute their portion of the pin pressure to the full cross section of the member.

34. Pins shall be long enough to insure a full bearing of all parts connected upon the turned-down body of the pin. Members packed on pins shall be held against lateral movement.

WORKMANSHIP

35. *General.* The workmanship shall be equal to the best practice in modern structural works. Shearing shall be done accurately, and all portions of the work exposed to view shall be neatly finished.

SPECIFICATIONS FOR STEEL FRAMED STRUCTURES.—*Continued*

36. *Punching.* The diameter of the punch shall not be more than $\frac{1}{16}$ inch, nor that of the die more than $\frac{1}{8}$ inch, larger than the diameter of the rivet. Punching shall be done accurately, but an occasional slight inaccuracy in the matching of holes may be corrected with reamer. Drifting to enlarge unfair holes will not be allowed.

37. *Riveting.* The size of rivets shall be as called for on the plans. Rivets shall be driven by pressure tools wherever possible. Pneumatic hammers shall be used in preference to hand driving. Rivets shall look neat and finished, with heads of approved shape, full and of equal size. They shall be centered on the shank and shall grip the assembled pieces firmly.

38. *Assembling.* Riveted members shall have all parts well pinned up and firmly drawn together with bolts before riveting is commenced. Contact surfaces shall be painted. Abutting joints shall be cut or dressed true and straight and fitted closely together. In compression joints depending on contact bearing, the surfaces shall be truly faced, so as to have even bearing after they are riveted up complete and when perfectly aligned. The several pieces forming one built member shall be straight and shall fit closely together, and finished members shall be free from twists, bends or open joints.

39. *Eye Bars.* Eye bars shall be straight and true to size, and shall be free from twists, folds in the neck or head, or any other defect. Heads shall be made by upsetting, rolling or forging. Welding will not be allowed. Before boring, each eye bar shall be perfectly annealed and carefully straightened. Pin holes shall be in the center line of bars and in the center of heads. Bars of the same length shall be bored so accurately that, when placed together, pins $\frac{1}{32}$ inch smaller in diameter than the pin holes can be passed through the holes at both ends of the bars at the same time.

40. *Pins.* Pins and rollers shall be turned accurately to gauges, and shall be straight, smooth and entirely free from flaws. Pin holes shall be bored true to gauges, smooth and straight, at right angles to the axis of the member and parallel to each other, unless otherwise called for. Wherever possible, the boring shall be done after the member is riveted up. The distance from center to center of pin holes shall be correct within $\frac{1}{32}$ inch, and the diameter of the hole not more than $\frac{1}{50}$ inch larger than that of the pin for pins up to 5 inches diameter, and $\frac{1}{32}$ inch for larger pins.

41. *Bed Plates.* Expansion bed plates shall be planed true and smooth. The cut of the planing tool shall correspond with the direction of expansion.

42. *Annealing.* Steel, except in minor details, which has been partially

SPECIFICATIONS FOR STEEL FRAMED STRUCTURES.—*Continued*

heated, shall be properly annealed. Welds in steel will not be allowed. All steel castings shall be annealed.

43. *Painting.* Steelwork, before leaving the shop, shall be thoroughly cleaned and given one good coating of such paint as may be called for, well worked into all joints and open spaces.

44. In riveted work, the surfaces coming in contact shall be painted before being riveted together.

45. Machine finished bearing surfaces coming in contact with similar surfaces should be coated with white lead and tallow before shipment.

46. *Inspection.* The manufacturer shall furnish all facilities for inspecting and testing the weight, quality of material and workmanship. He shall furnish a suitable testing machine for testing the specimens, as well as prepare the pieces for the machine free of charge.

47. He shall give the inspector for the purchaser free access to all parts of the works where the material under inspection is manufactured.

STEEL DERRICKS AND DRILLING RIGS

Steel Derricks and Drilling Rigs are manufactured by Carnegie Steel Company for use in drilling wells for oil, gas, salt, etc., and for mineral exploration work. They are made for use with cable tools, rotary tools and in combinations with derricks 55 ft. (16.76 meters), 64 ft. (19.51 meters), 72 ft. (21.95 meters), 80 ft. (24.38 meters), 86 ft. (26.21 meters) and 106 ft. (32.31 meters) high to recognized standards as to base and top dimensions, arrangement of machinery, etc. They are made with Woodworth, Yorke or Foukes joints for use over shallow wells or in the very heaviest service.

For full particulars as to sizes, working loads and methods of erection, see special pamphlet entitled Steel Derricks and Drilling Rigs, which will be furnished on request.

STANDARD SPECIFICATIONS FOR STRUCTURAL STEEL FOR BUILDINGS

SERIAL DESIGNATION: A9-16

ADOPTED 1901; REVISED 1909, 1913, 1914, 1916 BY THE
AMERICAN SOCIETY FOR TESTING MATERIALS
AFFILIATED WITH THE
INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS

(For the Metric equivalents of the dimensions and weights given in these specifications, refer to the tables given on Pages 14 to 28.)

I. MANUFACTURE

Process

1. (*a*) Structural steel, except as noted in Paragraph (*b*), may be made by the Bessemer or the Open Hearth process.

(*b*) Rivet steel, and steel for plates or angles over ¾-inch in thickness which are to be punched, shall be made by the Open Hearth process.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition

2. The steel shall conform to the following requirements as to chemical composition:

		Structural Steel	Rivet Steel
Phosphorus	Bessemer	Not over 0.10%	
	Open Hearth	Not over 0.06%	Not over 0.06 %
Sulphur			Not over 0.045%

Ladle Analyses

3. An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of carbon, manganese, phosphorus and sulphur. This analysis shall be made from a test ingot taken during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, and shall conform to the requirements specified in Section 2.

Check Analyses

4. Analyses may be made by the purchaser from finished material representing each melt. The phosphorus and sulphur content thus determined shall not exceed that specified in Section 2 by more than 25 per cent.

SPECIFICATIONS FOR STRUCTURAL STEEL FOR BUILDINGS.—*Continued*

III. PHYSICAL PROPERTIES AND TESTS

Tension Tests

5. (*a*) The material shall conform to the following requirements as to tensile properties:

Properties Considered	Structural Steel	Rivet Steel
Tensile strength, lbs. per sq. in.	55 000–65 000	46 000–56 000
Yield point, min., lb. per sq. in.	0.5 tens. str.	0.5 tens. str.
Elongation in 8 in., min, per cent.	$\frac{1\,400\,000^{a}}{\text{Tens. str.}}$	$\frac{1\,400\,000}{\text{Tens. str.}}$
Elongation in 2 in., min., per cent. . .	22	. . . .

[a] See Section 6.

(*b*) The yield point shall be determined by the drop of the beam of the testing machine.

Modifications in Elongation

6. (*a*) For structural steel over ¾-inch in thickness, a deduction of 1 from the percentage of elongation in 8 inches specified in Section 5 (*a*) shall be made for each increase of ⅛ inch in thickness above ¾ inch, to a minimum of 18 per cent.

(*b*) For structural steel under $\frac{5}{16}$ inch in thickness, a deduction of 2.5 from the percentage of elongation in 8 inches specified in Section 5(*a*) shall be made for each decrease of $\frac{1}{16}$ inch in thickness below $\frac{5}{16}$ inch.

Bend Tests

7. (*a*) The test specimen for plates, shapes and bars, except as specified in Paragraphs (*b*) and (*c*), shall bend cold through 180 degrees without cracking on the outside of the bent portion, as follows: For material ¾ inch or under in thickness, flat on itself; for material over ¾ inch to and including 1¼ inches in thickness, around a pin the diameter of which is equal to the thickness of the specimen; and for material over 1¼ inches in thickness, around a pin the diameter of which is equal to twice the thickness of the specimen.

(*b*) The test specimen for pins, rollers and other bars, when prepared as specified in Section 8 (*e*), shall bend cold through 180 degrees around a 1-inch pin without cracking on the outside of the bent portion.

(*c*) The test specimen for rivet steel shall bend cold through 180 degrees flat on itself without cracking on the outside of the bent portion.

Test Specimens

8. (*a*) Tension and bend test specimens shall be taken from rolled steel in the condition in which it comes from the rolls, except as specified in Paragraph (*b*).

SPECIFICATIONS FOR STRUCTURAL STEEL FOR BUILDINGS.—*Continued*

(*b*) Tension and bend test specimens for pins and rollers shall be taken from the finished bars, after annealing when annealing is specified.

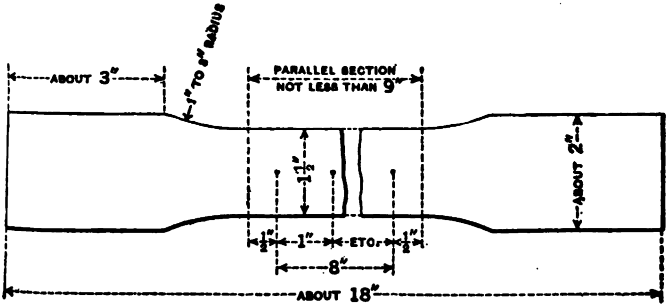


Figure 1

(*c*) Tension and bend test specimens for plates, shapes and bars, except as specified in Paragraphs (*d*), (*e*) and (*f*), shall be of the full thickness of material as rolled; and may be machined to the form and dimensions shown in Figure 1, or with both edges parallel.

(*d*) Tension and bend test specimens for plates over 1½ inches in thickness may be machined to a thickness or diameter of at least ¾ inch for a length of at least 9 inches.

(*e*) Tension test specimens for pins, rollers and bars over 1½ inches in thickness or diameter may conform to the dimensions shown in Figure 2. In this case the ends shall be of a form to fit the holders of the testing machine in such a way that the load shall be axial. Bend test specimens may be 1 by ½ inch in section. The axis of the specimens shall be located at any point midway between the center and surface and shall be parallel to the axis of the bar.

(*f*) Tension and bend test specimens for rivet steel shall be of the full-size section of bars as rolled.

Number of Tests

9. (*a*) One tension and one bend test shall be made from each melt; except that if material from one melt differs ⅜ inch or more in thickness, one tension and one bend test shall be made from both the thickest and the thinnest material rolled.

(*b*) If any test specimen shows defective machining or

SPECIFICATIONS FOR STRUCTURAL STEEL FOR BUILDINGS.—*Continued*

develops flaws, it may be discarded and another specimen substituted.

(*c*) If the percentage of elongation of any tension test specimen is less than that specified in Section 5 (*a*) and any part of the fracture is more than ¾ inch from the center of the gauge length of a 2-inch specimen or is outside the middle third of the gauge length of an 8-inch specimen as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

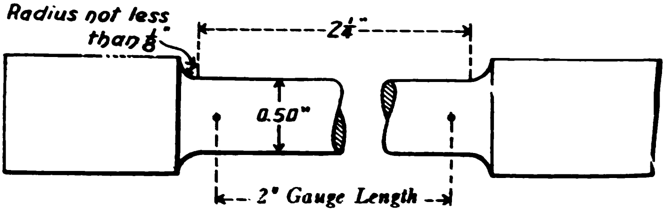


Figure 2

NOTE.—The gauge length, parallel portions and fillets shall be as shown but the ends may be of any form which will fit the holders of the testing machine.

IV. PERMISSIBLE VARIATIONS IN WEIGHT AND THICKNESS

10. The cross-section or weight of each piece of steel shall not vary more than 2.5 per cent. from that specified; except in the case of sheared plates, which shall be covered by the following permissible variations. One cubic inch of rolled steel is assumed to weigh 0.2833 pound. Permissible Variations

(*a*) *When Ordered to Weight per Square Foot:* The weight of each lot[1] in each shipment shall not vary from the weight ordered more than the amount given in Table I.

(*b*) *When Ordered to Thickness:* The thickness of each plate shall not vary more than 0.01 inch under that ordered. The overweight of each lot[2] in each shipment shall not exceed the amount given in Table II.

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[1] The term "lot" applied to Table I means all of the plates of each group width and group weight.

[2] The term "lot" applied to Table II means all of the plates of each group width and group thickness.

SPECIFICATIONS FOR STRUCTURAL STEEL FOR BUILDINGS.—*Continued*

TABLE I.—PERMISSIBLE VARIATIONS OF PLATES ORDERED TO WEIGHT

ORDERED WEIGHT, POUNDS PER SQ. FT.	PERMISSIBLE VARIATIONS IN AVERAGE WEIGHTS PER SQUARE FOOT OF PLATES FOR WIDTHS GIVEN, EXPRESSED IN PERCENTAGES OF ORDERED WEIGHTS																		ORDERED WEIGHT, POUNDS PER SQ. FT.
	Under 48 in.		48 to 60 in. excl.		60 to 72 in. excl.		72 to 84 in. excl.		84 to 96 in. excl.		96 to 108 in. excl.		108 to 120 in. excl.		120 to 132 in. excl.		132 in. or over		
	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	
Under 5	5	3	5.5	3	6	3	7	3	...	...	...	...	...	...	...	...	...	...	Under 5
5 to 7.5 excl.	4.5	3	5	3	5.5	3	5	3	...	...	...	...	...	...	...	...	...	...	5 to 7.5 excl.
7.5 to 10 excl.	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	...	...	...	...	7.5 to 10 excl.
10 to 12.5 excl.	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	9	3	10 to 12.5 excl.
12.5 to 15 excl.	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	12.5 to 15 excl.
15 to 17.5 excl.	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	15 to 17.5 excl.
17.5 to 20 excl.	2.5	2	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	17.5 to 20 excl.
20 to 25 excl.	2	2	2.5	2	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	20 to 25 excl.
25 to 30 excl.	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	4.5	3	5	3	25 to 30 excl.
30 to 40 excl.	2	2	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	4.5	3	30 to 40 excl.
40 or over	2	2	2	2	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	40 or over

NOTE.—The weight per square foot of individual plates shall not vary from the ordered weight by more than 1⅛ times the amount given in this table.

TABLE II.—PERMISSIBLE OVERWEIGHTS OF PLATES ORDERED TO THICKNESS

ORDERED THICKNESS, INCHES	PERMISSIBLE EXCESS IN AVERAGE WEIGHTS PER SQUARE FOOT OF PLATES FOR WIDTHS GIVEN, EXPRESSED IN PERCENTAGES OF NOMINAL WEIGHTS									ORDERED THICKNESS, INCHES
	Under 48 in.	48 to 60 in., excl.	60 to 72 in., excl.	72 to 84 in., excl.	84 to 96 in., excl.	96 to 108 in., excl.	108 to 120 in., excl.	120 to 132 in., excl.	132 in. or over	
Under ⅛	9	10	12	14	....	....	...	....	....	Under ⅛
⅛ to 3/16 excl.	8	9	10	12	....	....	....	....	....	⅛ to 3/16 excl.
3/16 to ¼ excl.	7	8	9	10	12	....	....	....	....	3/16 to ¼ excl.
¼ to 5/16 excl.	6	7	8	9	10	12	14	16	19	¼ to 5/16 excl.
5/16 to ⅜ excl.	5	6	7	8	9	10	12	14	17	5/16 to ⅜ excl.
⅜ to 7/16 excl.	4.5	5	6	7	8	9	10	12	15	⅜ to 7/16 excl.
7/16 to ½ excl.	4	4.5	5	6	7	8	9	10	13	7/16 to ½ excl.
½ to ⅝ excl.	3.5	4	4.5	5	6	7	8	9	11	½ to ⅝ excl.
⅝ to ¾ excl.	3	3.5	4	4.5	5	6	7	8	9	⅝ to ¾ excl.
¾ to 1 excl.	2.5	3	3.5	4	4.5	5	6	7	8	¾ to 1 excl.
1 or over	2.5	2.5	3	3.5	4	4.5	5	6	7	1 or over

SPECIFICATIONS FOR STRUCTURAL STEEL FOR BUILDINGS.—*Continued*

V. FINISH

Finish

11. The finished material shall be free from injurious defects and shall have a workmanlike finish.

VI. MARKING

Marking

12. The name or brand of the manufacturer and the melt number shall be legibly stamped or rolled on all finished material, except that rivet and lattice bars and other small sections shall, when loaded for shipment, be properly separated and marked for identification. The identification marks shall be legibly stamped on the end of each pin and roller. The melt number shall be legibly marked, by stamping if practicable, on each test specimen.

VII. INSPECTION AND REJECTION

nspection

13. The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection

14. (*a*) Unless otherwise specified, any rejection based on tests made in accordance with Section 4 shall be reported within five working days from the receipt of samples.

(*b*) Material which shows injurious defects subsequent to its acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

Rehearing

15. Samples tested in accordance with Section 4, which represent rejected material, shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

STEEL FOR SHIPBUILDING PURPOSES
STANDARD PRACTICE

To insure the most economical production and most prompt shipment of steel for shipbuilding purposes, orders should reach the manufacturers in the form best suited for rolling mill operations. To effect this end, ship building practice should conform to uses established as standard in the fabrication of shapes and plates for bridges, buildings and cars. Useless and minute variations should be absolutely eliminated.

Specifications should be placed as far ahead of desired time of shipment as possible, so as to permit the most intelligent operation of mills to suit ship builders' requirements. Changes, revisions, cancellations, etc., after orders are at the mills, cause delay in manufacture and shipment.

Orders should be written up as simply as possible, and the system of numbering should likewise be simple and complete, so that there are not many different items to consider as order numbers. The most satisfactory method is to assign a hull number to each vessel, to use that hull number as an order number, and to number order sheets from 1–99 for shapes, 100–199 for plates, etc.

Orders for steel for each vessel should be placed complete at one time and should be written up so that items in each group follow each other in the rotation required at the ship-yards. Orders should contain complete information as to all details of manufacture when they are placed.

Steel for each boat should be on a separate order, distinct and complete in every detail; provided, however, that when a number of boats under construction at one yard are identical, it will not be necessary to accompany an order for material for several boats by several lists of material; one list with complete specification for one boat will be sufficient, provided there is a statement on the general order sheet, that the list covers material for one boat only, and that material for several boats is required, and provided that, when such order is not liable to subsequent change as to character of steel, time of shipment or destination; but in no event should steel for more than four boats be written up on one general order.

It is, therefore, recommended that the following be the basis on which sizes shall be specified on drawings and orders for steel for cargo and other vessels.

STEEL FOR SHIPBUILDING PURPOSES.—STANDARD PRACTICE.—*Continued*

Structural Shapes

1. That shapes be specified on drawings and mill orders only to the published weights or dimensions; that the use of bulb beams, tees (with the exception of 6½ x 6½ inch section), and zees be eliminated; and that, as far as possible, shapes for ship construction be confined to plain angles, bulb angles and ship channels.

Standard Sizes of Structural Shapes

2. That though, if tonnage is available, Carnegie Steel Company can and will roll all the sections shown in its published lists, to insure prompt shipment designs should, as a rule be limited to the following sections in most common use:

(*a*) *Equal Leg Angles*—6 x 6, 5 x 5, 4 x 4, 3½ x 3½, 3 x 3, 2½ x 2½ and 2 x 2 inches.

(*b*) *Unequal Leg Angles*—6 x 3½, 5 x 3, 4 x 3, 3½ x 3 and 3 x 2½ inches.

(*c*) *Bulb Angles*—10 x 3½, 9 x 3½, 8 x 3½, 7 x 3½ and 6 x 3 inches.

(*d*) *Ship Channels*—12 x 3½, 10 x 3½, 9 x 3½, 8 x 3½, 7 x 3½ and 6 x 3½ inches.

(*e*) *Structural Channels*—15-inch, C-1, and 4-inch, C-200.

(*f*) *H-Beams*—8-inch, H-4; 6-inch, H-3; 5-inch, H-2, and 4-inch, H-1.

(*g*) *Tees*—6½ x 6½ inches.

Plates

3. That plates be specified on drawings and mill orders to thicknesses in fractions of an inch (or to the weights in pounds per square foot thereto approximately corresponding as shown in Column No. 6 on the table which follows), and that thicknesses be in multiples of $\frac{1}{16}$ inch and $\frac{1}{32}$ inch where necessary.

Sketch Plates

4. That sketch plates be ordered in multiple and cut to size at the shipyards, rolling mills to furnish to sketch only straight double or single taper plates.

Universal Mill Plates

5. That within universal plate mill limits (48 inches wide or less) plates be furnished sheared or universal at mills' option. Where sheared plates within these limits are absolutely necessary, orders should be marked "sheared only."

STEEL FOR SHIPBUILDING PURPOSES.—STANDARD PRACTICE.—*Continued*

Multiple-Width Plates

6. That plates narrower than 18 inches (preferably narrower than 24 inches) and lighter than ¼ inch be ordered in multiple widths, to be recut at the shipyards to the widths desired for final use.

Extreme-Size Plates

7. That, though Carnegie Steel Company can and will roll extreme sizes of plates shown in its published lists, where designs will permit, such extreme sizes, both as to widths and lengths, be avoided.

Flange Plates

8. That, when flanging is to be done on ship steel, orders be plainly marked "For Hot Flanging" or "For Cold Flanging" as required.

Bars

9. That bars be ordered in accordance with Clause 10, and that, when small tonnages are needed, ship yards carry stock in order to avoid unusual delay incident to individual rollings.

Lengths

10. That to make more available for use all material rolled, where unit lengths are known, plates, shapes and bars be rdered in such unit lengths, with permission, when possible, o furnish in multiples of unit lengths, any allowance for utting at ship yards to be specifically mentioned. Stock engths to provide a working range in cutting.

Specifications for Quality

11. That the steel be manufactured in accordance with re-uirements of the American Bureau of Shipping or Lloyd's egister of Shipping or to specifications A-12-16 of the merican Society for Testing Materials, (see pages 565 to 569 f this catalogue) as may be called for by shipbuilders' hedules and subject to testing and inspection at the mill.

Marking

12. That in addition to stamping required by above specifi-ations and classification inspections, mills mark material nly with hull number and item number, when shipbuilders' hedules call for this system of marking.

NOTE 1.—In the tables which follow the bulb angle sections, apart from a few small sizes d the ship building channel sections are the new American standard sections adopted at a nference of steel makers in Philadelphia, November 19, 1918. Where they are identical with ritish standards, the point of identity is indicated by bold face type and by the insertion of the ritish standard section number.

NOTE 2.—By ***British Standards*** are meant those particular shapes adopted by the Engineer-g Standards Committee and shown by reference numbers in book entitled Properties of ritish Standard Sections, London, July, 1904. English steel makers roll British standard sec-ons from the base dimensions to minimum and maximum thicknesses, which differ between ills in accordance with the capacities of the mills and the requirements of their particular ade.

NOTE 3.—Orders should specify in every case the Carnegie section number and the weight per ot.

For other information on the subject of steel for shipbuilding purposes, see special pamphlet hich will be furnished on request.

STEEL FOR SHIPBUILDING PURPOSES.—STANDARD PRACTICE.—*Continued*

WEIGHTS OF FLAT ROLLED STEEL

(For use in ordering Ship Plates)

Thickness				Weight		
Fraction of an Inch	Decimal of an Inch		Millimeters, Approximate	Pounds per Square Foot		Kilos per Square Mete
	Exact	Approximate		Exact	Approximate	Approximate
¼	.250	.25	6.35	10.200	10.2	49.80
9/32	.28125	.28	7.14	11.475	11.5	56.03
5/16	.3125	.31	7.94	12.750	12.8	62.25
11/32	.34375	.34	8.73	14.025	14.0	68.48
⅜	.375	.38	9.53	15.300	15.3	74.70
13/32	.40625	.41	10.32	16.575	16.6	80.93
7/16	.4375	.44	11.11	17.850	17.9	87.15
15/32	.46875	.47	11.91	19.125	19.1	93.38
½	.500	.50	12.70	20.400	20.4	99.60
17/32	.53125	.53	13.49	21.675	21.7	105.83
9/16	.5625	.56	14.29	22.950	23.0	112.05
19/32	.59375	.59	15.08	24.225	24.2	118.28
⅝	.625	.63	15.88	25.500	25.5	124.50
21/32	.65625	.66	16.67	26.775	26.8	130.73
11/16	.6875	.69	17.46	28.050	28.1	136.95
23/32	.71875	.72	18.26	29.325	29.3	143.18
¾	.750	.75	19.05	30.600	30.6	149.40
25/32	.78125	.78	19.84	31.875	31.9	155.63
13/16	.8125	.81	20.64	33.150	33.2	161.85
27/32	.84375	.84	21.43	34.425	34.4	168.08
⅞	.875	.88	22.23	35.700	35.7	174.30
29/32	.90625	.91	23.02	36.975	37.0	180.53
15/16	.9375	.94	23.81	38.250	38.3	186.75
31/32	.96875	.97	24.61	39.525	39.5	192.98
1	1.000	1.00	25.40	40.800	40.8	199.20

Ship plates should be ordered either to thickness in fractions of an inch, as per Column 1, or to approximate weight in pounds per square foot, as per Column 6.

Plates should be ordered to nearest sixteenth-inch thickness.

Thicknesses in thirty-seconds of an inch or weight equivalents, while permitted, should be avoided wherever possible.

STANDARD SPECIFICATIONS FOR STRUCTURAL STEEL FOR SHIPS

SERIAL DESIGNATION: A12-16

ADOPTED, 1901; REVISED, 1909, 1913, 1914, 1916 BY THE
AMERICAN SOCIETY FOR TESTING MATERIALS
PHILADELPHIA, PA., U. S. A.
AFFILIATED WITH THE
INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS

(For the Metric equivalents of the dimensions and weights given in these specifications, refer to the tables on Pages 14 to 28.)

I. MANUFACTURE

Process

1. The steel shall be made by the open-hearth process.

II. CHEMICAL PROPERTIES AND TESTS

Chemical Composition

2. The steel shall conform to the following requirements as to chemical composition:

Phosphorus	Acid	not over 0.06 per cent.
	Basic	not over 0.04 per cent.
Sulphur		not over 0.05 per cent.

Ladle Analyses

3. An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of carbon, man- anese, phosphorus and sulphur. This analysis shall be made rom a test ingot taken during the pouring of the melt. The hemical composition thus determined shall be reported to the urchaser or his representative, and shall conform to the re- uirements specified in section 2.

Check Analyses

4. Analyses may be made by the purchaser from finished aterial representing each melt. The phosphorus and sul- ur content thus determined shall not exceed that specified in ction 2 by more than 25 per cent.

A. S. T. M. SPECIFICATIONS FOR STRUCTURAL STEEL FOR SHIPS.—*Co*

III. PHYSICAL PROPERTIES AND TESTS

Tension Tests

5. (*a*) The material shall conform to the follow quirements as to tensile properties:

Tensile strength	lb. per sq. inch	58,000-68,0
Yield point, min.	lb. per sq. inch	0.5 tens. st
Elongation in 8 inches, min. See section 6.	per cent.	$\frac{1,500}{\text{tens.}}$

(*b*) The yield point shall be determined by the the beam of the testing machine.

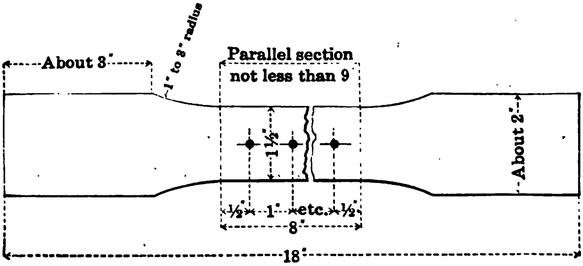


Figure 1

Modifications in Elongation

6. (*a*) For material over ¾ inch in thickness, a de of 1 from the percentage of elongation specified in secti shall be made for each increase of ⅛ inch in thickness ¾ inch, to a minimum of 18 per cent.

(*b*) For material ¼ inch or under in thickne elongation shall be measured on a gauge length of 24 ti thickness of the specimen.

Bend Tests

7. The test specimen shall bend cold through 180 without cracking on the outside of the bent portion, as f For material ¾ inch or under in thickness, around a diameter of which is equal to the thickness of the spe for material over ¾ inch to and including 1¼ inch in ness, around a pin the diameter of which is equal to 1 the thickness of the specimen; and for material over 1 in thickness, around a pin the diameter of which is e twice the thickness of the specimen.

S. T. M. SPECIFICATIONS FOR STRUCTURAL STEEL FOR SHIPS.—*Continued*

Test Specimens

8. (*a*) Tension and bend test specimens shall be taken om the finished rolled material, and shall not be annealed otherwise treated, except as specified in paragraph (*b*).

(*b*) Tension and bend test specimens for material which to be annealed or otherwise treated before use, shall be cut m properly annealed or similarly treated short lengths of full section of the piece.

(*c*) Tension and bend test specimens, except as speci- d in paragraph (*d*), shall be of the full thickness of material rolled; and may be machined to the form and dimensions wn in Fig. 1, or with both edges parallel.

(*d*) Tension and bend test specimens for plates and rs over 1½ inch in thickness or diameter may be machined a thickness or diameter of at least ¾ inch for a length of at st 9 inches.

Number of Tests

9. (*a*) One tension and one bend test shall be made from h melt; except that if material from one melt differs ⅜ h or more in thickness, one tension and one bend test shall made from both the thickest and the thinnest material led.

(*b*) If any test specimen shows defective machining or elops flaws, it may be discarded and another specimen stituted.

(*c*) If the percentage of elongation of any tension test cimen is less than that specified in section 5(*a*) and any part the fracture is outside the middle third of the gauge length, ndicated by scribe scratches marked on the specimen before ing, a retest shall be allowed.

IV. PERMISSIBLE VARIATIONS IN WEIGHT AND THICKNESS.

Permissible Variations

0. The cross-section or weight of each piece of steel shall vary more than 2.5 per cent. from that specified; except he case of sheared plates, which shall be covered by the wing permissible variations. One cubic inch of rolled l is assumed to weigh 0.2833 pound.

(*a*) *When Ordered to Weight per Square Foot:* The ght of each lot[1] in each shipment shall not vary from the ght ordered more than the amount given in Table I.

he term "lot" applied to Table I means all of the plates of each group h and group weight.

STANDARD METHODS OF SAMPLING FOR CHECK ANALYSIS

MANUFACTURERS' STANDARD PRACTICE

ADOPTED 1912 BY THE
ASSOCIATION OF AMERICAN STEEL MANUFACTURERS

INTRODUCTION

It is a recognized fact that the different parts of a piece of steel are liable to vary in composition. This variation occurs principally between the center and the outside, and to a slighter extent is dependent upon the position of the piece in the ingot, and the size of the ingot.

Where a sufficient number of check analyses have been made from drillings properly taken at different points in the heat to represent it fairly, their average has been found to compare favorably with the ladle analysis, which is the analysis of a small test ingot taken at any time during the pouring of the heat.

From this it is evident:

1. That the ladle analysis is more representative of the composition than any single analysis of the finished material.

2. That drillings for check analysis, to be fairly representative, should be taken at a point intermediate between the outside and the center of the cross section.

3. That a sufficient number of check analyses of different pieces should be made to afford a fair average to compare with the ladle analysis.

I. POINTS TO BE OBSERVED IN THE SAMPLING OF MATERIAL FOR CHECK ANALYSIS

(*a*) Each heat in a lot shall be considered separately, and pieces for sampling shall be taken to represent the heat as fairly as possible.

(*b*) Samples must be drillings or chips cut by some machine tool without the application of water, oil or other lubricant and shall be free from scale, grease, dirt or other foreign substance. If samples are taken by drilling, the size of the drill shall be not less than ½ inch (12.70 m/m) nor more than ¾ inch (19.05 m/m) in diameter.

(*c*) Samples must be uniformly fine and each must be carefully mixed before analysis.

(*d*) In referring samples to the manufacturer or other analysts for check analysis, a piece of the full-size section, when possible, should be submitted rather than cuttings, unless the latter are specially requested.

STANDARD METHODS OF SAMPLING.—*Continued*

(*e*) Where material has been subjected to heat treatment other than ealing or simple cooling, subsequent to its manufacture, it should be ealed before sampling.

(*f*) Check analyses are not representative of the original material when omposition has been altered in any way by some operation such as case-dening, overheating, etc.

II. METHODS OF OBTAINING SAMPLES FOR CHECK ANALYSIS

Material has been divided into the following classes, depending upon the nner of sampling:

I. MATERIAL SUBJECT TO PHYSICAL REQUIREMENTS

Samples for check analysis shall be taken from a test specimen. Where it is uired to make additional check analyses, samples shall be taken as indicated der II.

I. MATERIAL NOT SUBJECT TO PHYSICAL REQUIREMENTS

(*a*) *Special cast, rolled or forged, semi-finished or finished material of large ze, such as Ingots, Blooms, Billets, Slabs, Rounds, Shapes, etc., subject to ceptance on check analysis.*

Samples shall be taken at any point midway between the outside and the nter by drilling parallel to the axis. In cases where this method is not acticable, a piece may be drilled on the side, but drillings shall not be taken til they represent the portion midway between the outside and the center. e Figure 1.

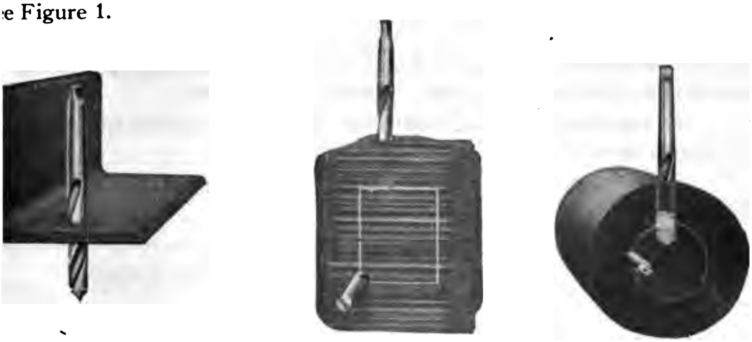


Figure 1

STANDARD METHODS OF SAMPLING.—*Continued*

(*b*) *Small or thin material, such as Plates, Shapes, Bars, etc., subject to acceptance on check analysis.*

Material for which the previous method is not applicable shall have samples for analysis taken entirely through the material at a point midway between the outside and the center, or by machining off the entire cross section.

(*c*) *Commercial material subject to acceptance on ladle analysis.*

The methods described under II (*a*) and (*b*) shall apply, except that samples shall be taken at any point one-third of the distance from the outside to the center.

III. METHODS OF ANALYSIS

Analyses shall be made by well-known accurate methods. Carbon shall be determined by the combustion method.

IV. REJECTION OF MATERIAL ON CHECK ANALYSIS

Any rejection of material ordered to a specific chemical range shall be based on the following:

(*a*) The minimum number of samples to be taken from a heat before rejection by the purchaser shall be as follows:

Weight in Gross Tons	Minimum Number of Samples
5 or less	3
10 or less but over 5	4
15 or less but over 10	5
over 15	6

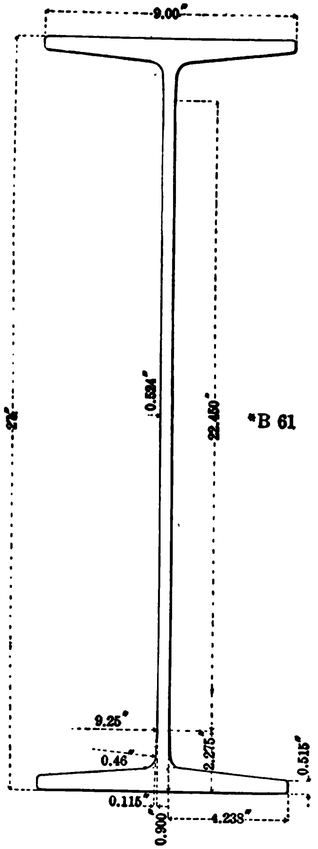
In case the number of pieces in a heat is less than the number of samples given, one sample from each piece shall be considered sufficient.

(*b*) Separate determinations shall be made on each sample and the results averaged, unless they clearly indicate mixed grades.

I-BEAMS

nufactured by Carnegie Steel Company and Illinois Steel Company.)

For tables of beam safe loads see pages 649 to 659.
For elements of beams see pages 646 to 648.

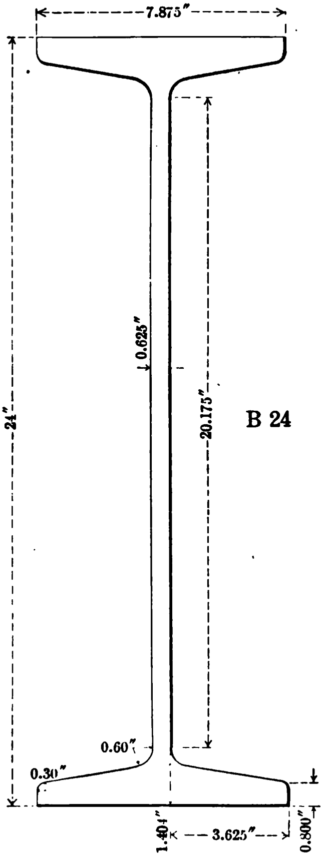


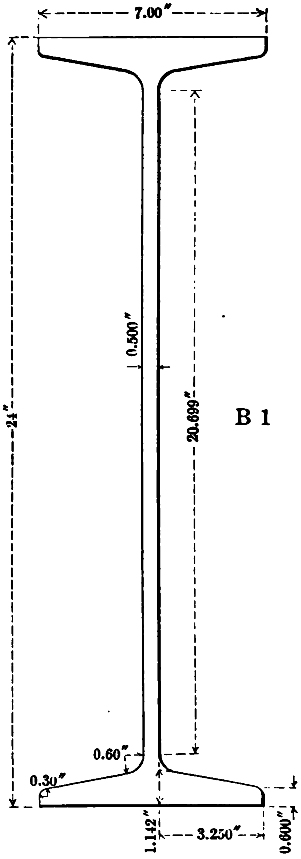
*B 61

on x	Depth of Beam		Weight		Flange Width		Web Thickness	
	Inches	m/m	Per Foot, Lbs.	Per Meter, Kilos	Inches	m/m	Inch	m/m
1	27	686	90	133.94	9	228.6	.524	13.31

plementary Beam, furnished only by special arrangement.

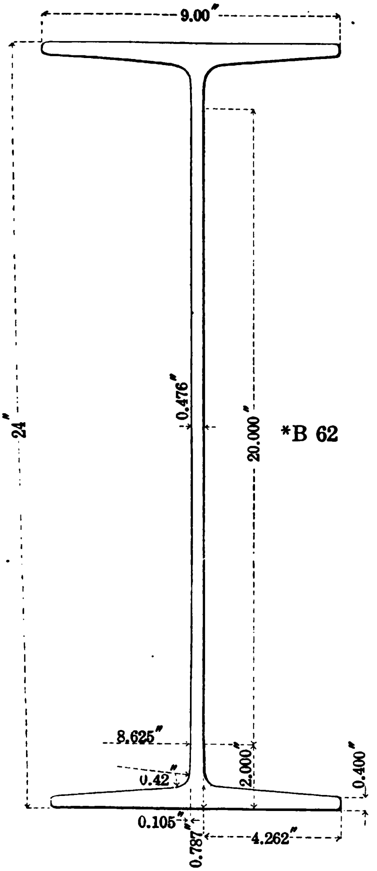
I-BEAMS.—*Continued*

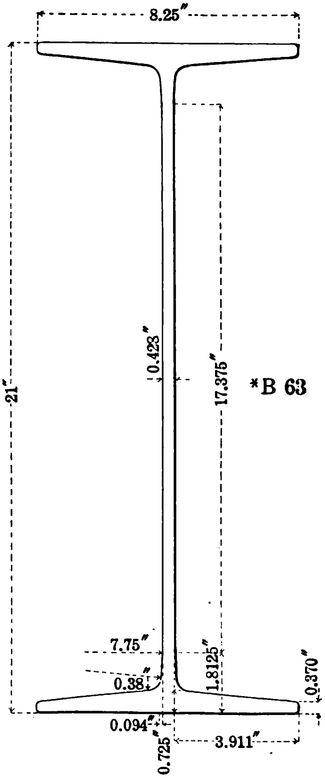




Section Index	Depth of Beam		Weight		Flange Width		Web Thicknes	
	Inches	m. m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inch	m/m
B 24	24	610	120 115 110 105	178.58 171.14 163.70 156.26	8 1/16 8 7 15/16 7 7/8	205 203 202 200	.812 .750 .688 .625	20.6 19.0 17.4 15.8
B 1	*24*	610	100 95 90 85 80	148.82 141.38 133.93 126.49 119.05	7 1/4 7 3/16 7 1/8 7 1/16 7	184 183 181 180 178	.754 .693 .631 .570 .500	19.1 17.6 16.0 14.4 12.7

I-Beams.—*Continued*

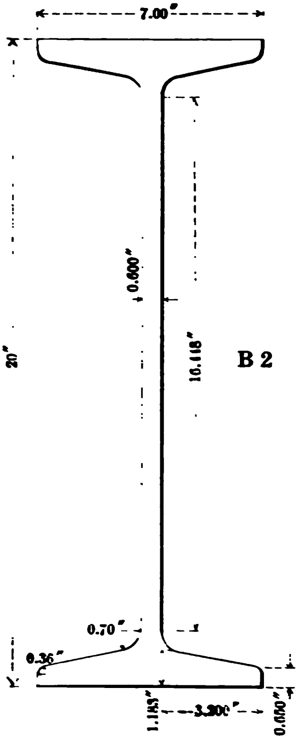


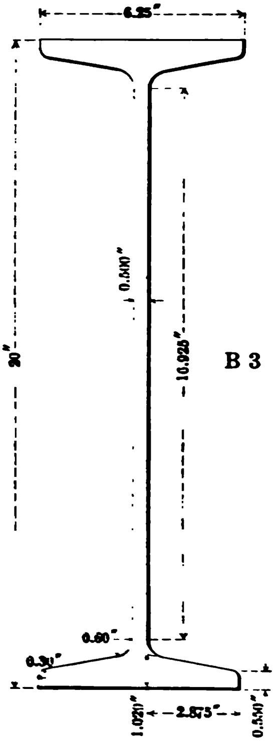


Section Index	Depth of Beam		Weight		Flange Width		Web Thickness	
	Inches	m/m	Per Foot, Lbs.	Per Meter, Kilos	Inches	m/m	Inch	m/m
*B 62	24	610	74	110.13	9	229	.476	12.09
*B 63	21	533	60½	90.04	8¼	210	.428	10.87

*Supplementary Beam, furnished only by special arrangement.

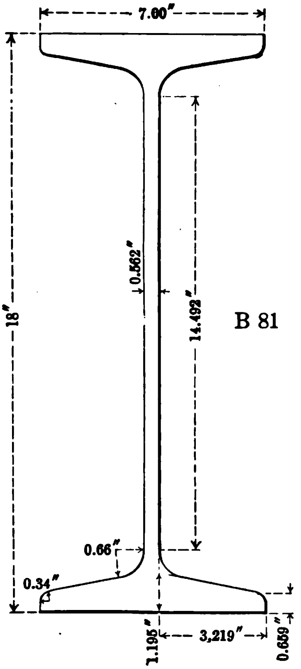
I-BEAMS.—*Continued*

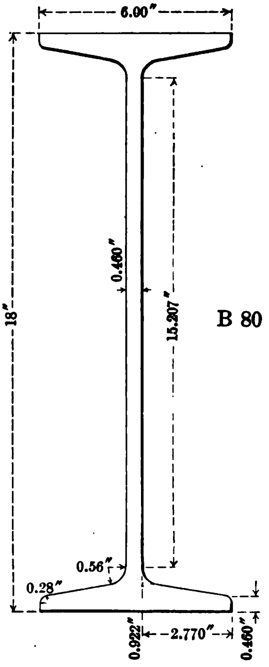




Section Index	Depth of Beam		Weight		Flange Width		Web Thickness	
	Inches	m m	Per Foot, Pound.	Per Meter. Kilos	Inches	m m	Inch	m/m
B 2	20	508	100	148.82	7 9/32	185	.884	22.45
			95	141.38	7 7/32	183	.810	20.57
			90	133.93	7 1/8	181	.737	18.72
			85	126.49	7 1/16	179	.663	16.84
			80	119.05	7	178	.600	15.24
B 3	20	508	75	111.61	6 13/32	163	.649	16.48
			70	104.17	6 5/16	161	.575	14.61
			65	96.73	6 1/4	159	.500	12.70

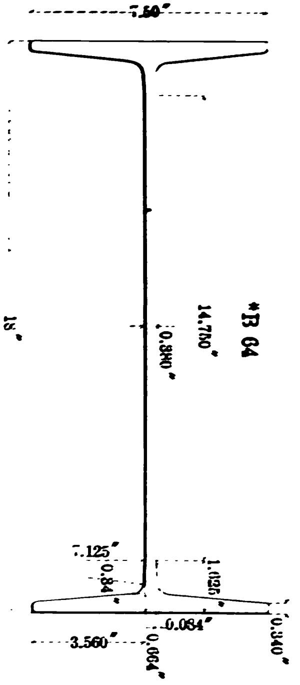
I-BEAMS.—*Continued*

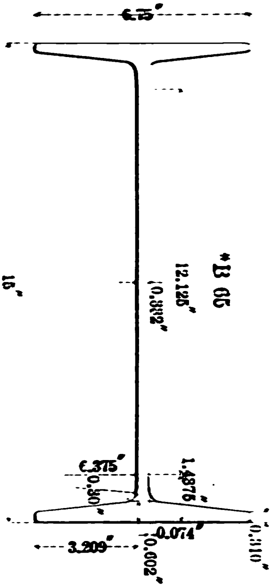




Section Index	Depth of Beam		Weight		Flange Width		Web Thickness	
	Inches	m/m	Per Foot, Lbs.	Per Meter, Kilos	Inches	m/m	Inch	m/m
			90	133.93	7¼	184	.807	20.50
B 81	18	457	85	126.49	7 5/32	182	.725	18.42
			80	119.05	7 3/32	180	.644	16.36
			75	111.61	7	178	.562	14.28
			70	104.17	6 17/64	159	.719	18.26
B 80	18	457	65	96.73	6 11/64	157	.637	16.18
			60	89.29	6 3/32	155	.555	14.10
			55	81.85	6	152	.460	11.68

I-BEAMS.—*Continued*

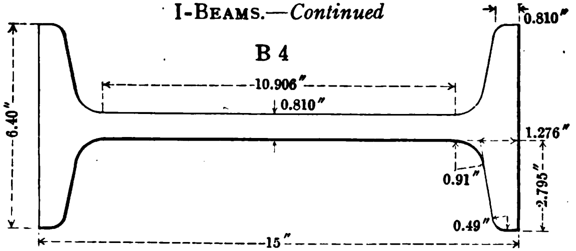




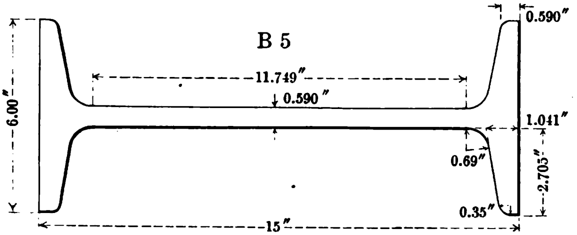
Section Index	Depth of Beam		Weight		Flange Width		Web Thickness	
	Inches	m m	Per Foot, Lbs.	Per Meter, Kilos	Inches	m m	Inch	m m
*B 64	18	457	48	71.43	7½	191	.380	9.65
*B 65	15	381	37½	55.81	6¾	171	.332	8.43

*Supplementary Beam, furnished only by special arrangement.

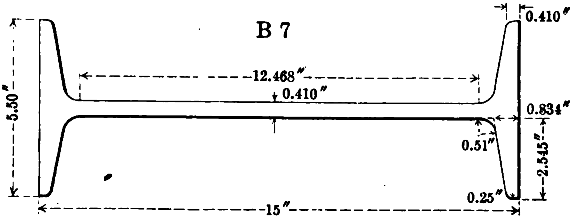
I-BEAMS.—*Continued*



B 4



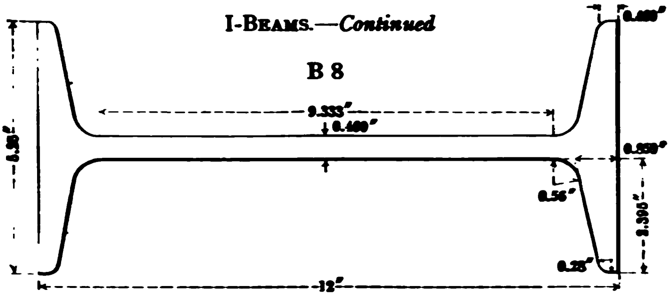
B 5

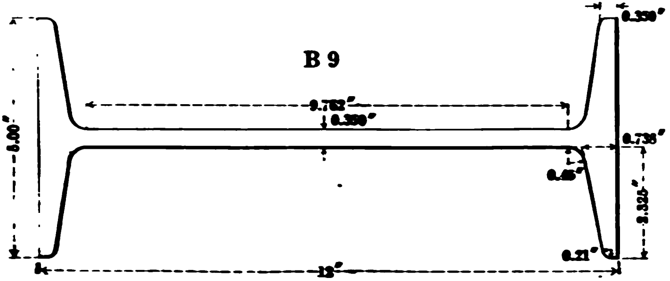


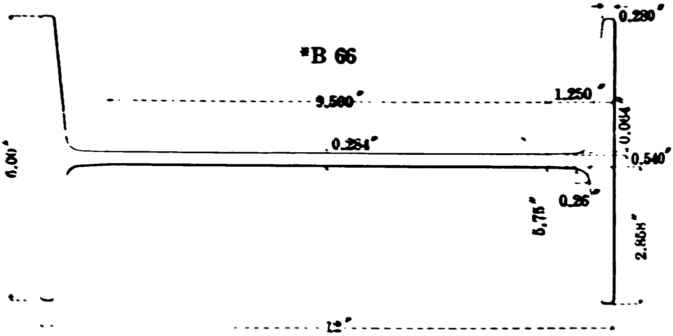
B 7

on ex	Depth of Beam		Weight		Flange Width		Web Thickness	
	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inches	m/m
	15	381	100	148.82	$6\frac{49}{64}$	172	1.183	30.05
			95	141.38	$6\frac{43}{64}$	170	1.085	27.56
			90	133.93	$6\frac{37}{64}$	167	.987	25.07
			85	126.49	$6\frac{31}{64}$	165	.889	22.58
			80	119.05	$6\frac{25}{64}$	163	.810	20.57
	15	381	75	111.61	$6\frac{19}{64}$	160	.882	22.40
			70	104.17	$6\frac{3}{16}$	157	.784	19.91
			65	96.73	$6\frac{3}{32}$	155	.686	17.42
			60	89.29	6	152	.590	14.99
	15	381	55	81.85	$5\frac{3}{4}$	146	.656	16.66
			50	74.41	$5\frac{41}{64}$	143	.558	14.17
			45	66.97	$5\frac{35}{64}$	141	.460	11.68
			42	62.50	$5\frac{1}{2}$	140	.410	10.41

I-Beams.—*Continued*



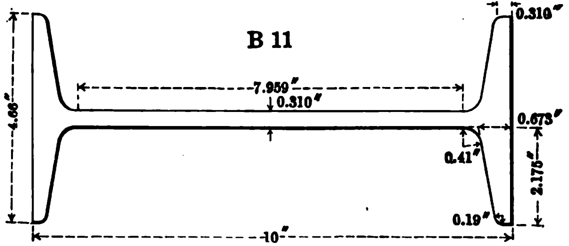


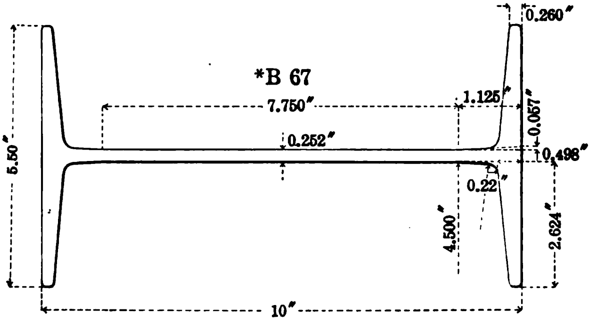


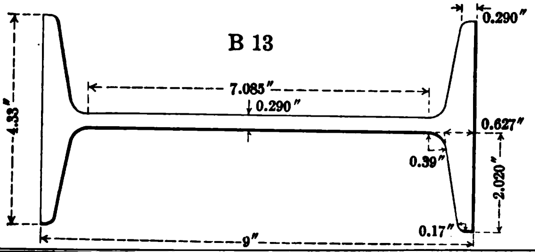
Section Index	Depth of Beam Inches	Depth of Beam m m	Weight Per Foot. Pounds	Weight Per Meter. Kilos	Flange Width Inches	Flange Width m m	Web Thickr Inch	m
B 8	12	305	55	81.85	5[illegible]	143	.821	20
			50	74.41	5[illegible]	139	.699	17
			45	66.97	5[illegible]	136	.576	14
			40	59.53	5¼	133	.460	11
B 9	12	305	35	52.09	5 1/16	129	.436	11
			31½	46.88	5	127	.350	8
*B 66	12	305	28	41.67	6	152	.284	7

*Supplementary Beam furnished only by special arrangement.

I-Beams.—*Continued*





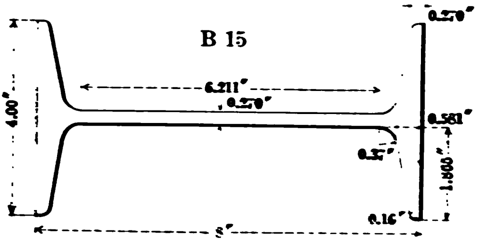


Depth of Beam		Weight		Flange Width		Web Thickness	
Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inch	m/m
10	254	40	59.53	5 3/32	130	.749	19.03
		35	52.09	4 15/16	126	.602	15.29
		30	44.65	4 13/16	122	.455	11.56
		25	37.20	4 21/32	118	.310	7.87
10	254	22½	33.11	5½	140	.252	6.40
9	229	35	52.09	4 25/32	121	.732	18.59
		30	44.65	4 19/32	117	.569	14.45
		25	37.20	4 15/32	113	.406	10.31
		21	31.25	4 11/32	110	.290	7.37

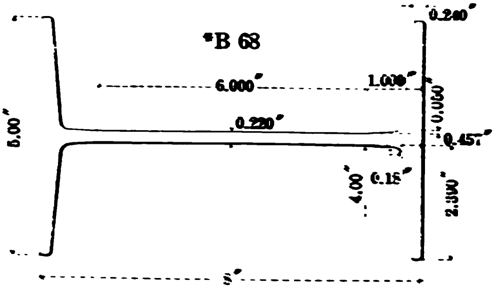
ementary Beam, furnished only by special arrangement.

I-BEAMS.—*Continued*

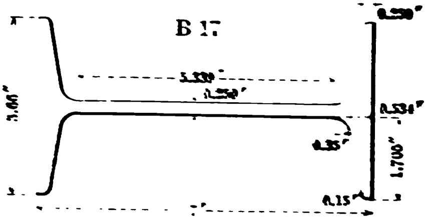
B 15



*B 68



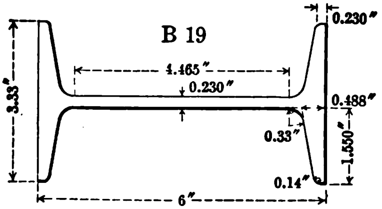
B 17

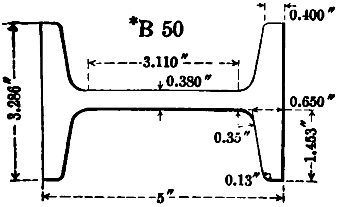


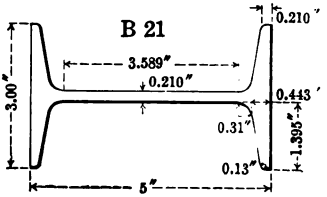
Section Index	Depth of Beam		Weight		Flange Width		Web Thickness	
	Inches	m m	Per Foot. Pounds	Per Meter. Kilos	Inches	m m	Inch	m m
B 15	8	203	25½	37.95	4 17/64	108	.541	13.74
			23	34.23	4 11/64	106	.449	11.41
			20½	30.51	4 5/64	104	.357	9.07
			18	26.79	4	102	.270	6.86
*B 68	8	203	17½	26.04	5	127	.220	5.59
B 17	7	178	20	29.76	3 7/8	98	.458	11.63
			17½	26.04	3 49/64	96	.353	8.97
			15	22.32	3 21/32	93	.250	6.35

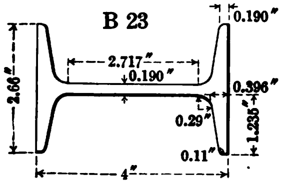
*Supplementary Beam furnished only by special arrangement.

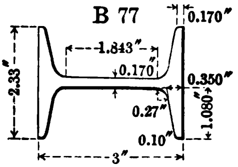
I-BEAMS.—*Continued*







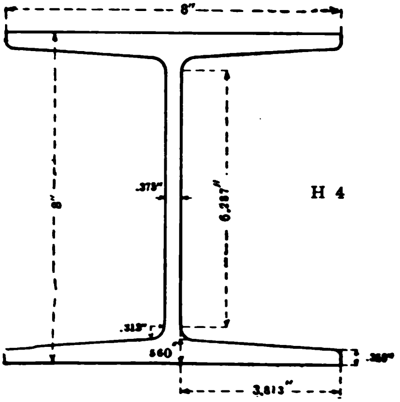


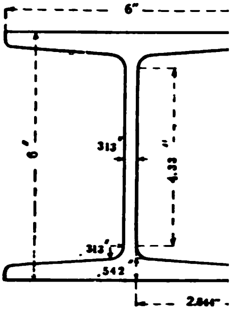


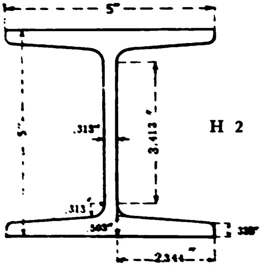
Section Index	Depth of Beam		Weight		Flange Width		Web Thickness	
	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inch	m/m
B 19	6	152	17¼	25.67	3 37/64	91	.475	12.07
			14¾	21.95	3 29/64	88	.352	8.94
			12¼	18.23	3 21/64	85	.230	5.84
*B 50	5	127	17	25.30	3 9/32	83	.380	9.65
B 21	5	127	14¾	21.95	3 19/64	84	.504	12.80
			12¼	18.23	3 9/64	80	.357	9.07
			9¾	14.51	3	76	.210	5.33
B 23	4	102	10½	15.63	2⅞	73	.410	10.41
			9½	14.14	2 13/16	71	.337	8.56
			8½	12.65	2 47/64	69	.263	6.68
			7½	11.16	2 21/32	68	.190	4.83
B 77	3	76	7½	11.16	2 33/64	64	.361	9.17
			6½	9.67	2 27/64	62	.263	6.68
			5½	8.19	2 21/64	59	.170	4.32

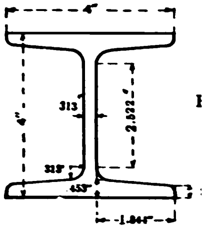
*Furnished only by special arrangement.

H-BEAMS
STEEL MINE TIMBERS





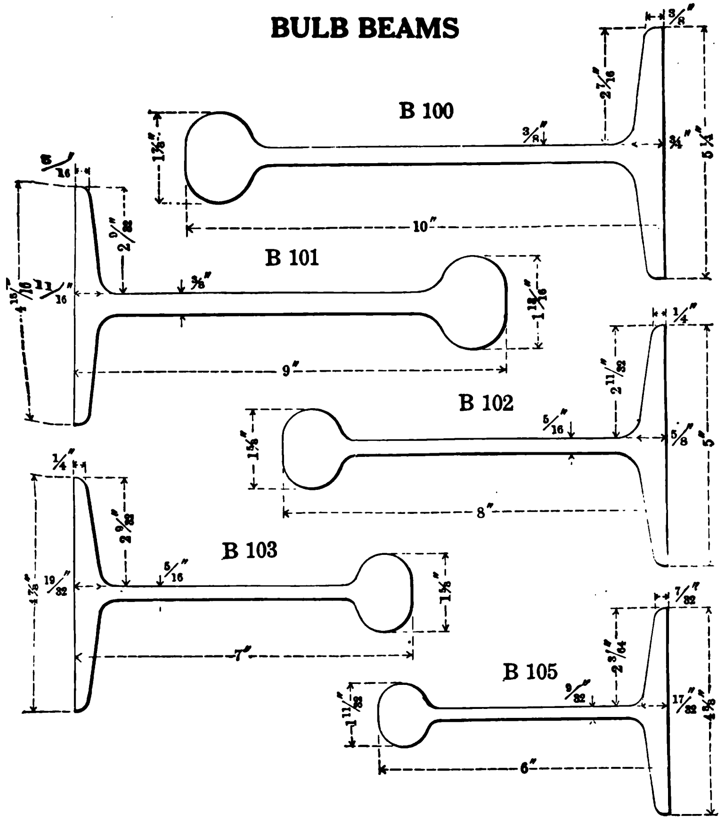




Section Index	Depth of Beam		Weight		Flange Width		Web T
	Inches	m m	Per Foot, Pounds	Per Meter, Kilos	Inches	m m	Inch
H 1	4	102	13.6	20.24	4	102	.313
H 2	5	127	18.7	27.83	5	127	.313
H 3	6	152	23.8	35.42	6	152	.313
H 4	8	203	34.0	50.60	8	203	.375

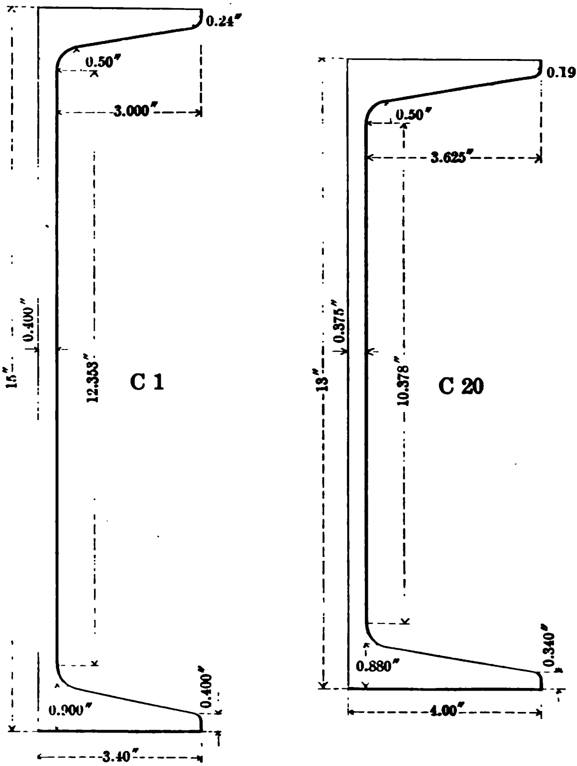
H-Beams shown on this page are specially adapted for use as props, struts ar timbering mines, for which steel possesses many advantages over wood. These be cut to length at the mills, or shipped in long lengths to be cut as required at They have been designed so as to be readily handled with the simplest of tools, on able beam shears being sufficiently strong to do the cutting with ease. A pamph "Steel Mine Timbers," illustrating various forms of construction for steel mine tin containing data and tables for the use of mining engineers, will be furnished on re

BULB BEAMS



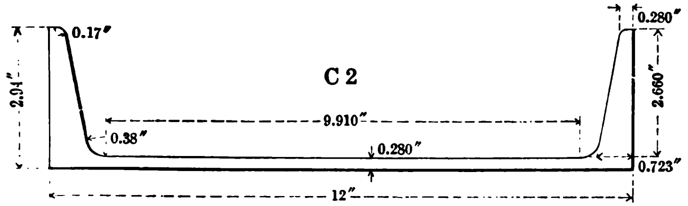
Section Index	Depth		Weight		Flange Width		Web Thickness		Increase in Web and Width for each additional	
	Ins.	m/m	Per Foot, Pounds	Per Meter, Kilos	Ins.	m/m	In.	m/m	Pound per Foot	Kilo per Meter
									In.	m/m
B 100	10	254	36.6 28.1	54.47 41.82	$5\frac{1}{2}$ $5\frac{1}{4}$	140 133	$\frac{5}{8}$ $\frac{3}{8}$	15.88 9.53	0.029	0.502
B 101	9	229	30.1 24.3	44.79 36.16	$5\frac{1}{8}$ $4\frac{15}{16}$	130 125	$\frac{9}{16}$ $\frac{3}{8}$	14.29 9.53	0.033	0.552
B 102	8	203	24.2 20.0	36.02 29.76	$5\frac{5}{32}$ 5	131 127	$\frac{15}{32}$ $\frac{5}{16}$	11.91 7.94	0.037	0.634
B 103	7	178	23.3 18.1	34.68 26.94	$5\frac{3}{32}$ $4\frac{7}{8}$	129 124	$\frac{17}{32}$ $\frac{5}{16}$	13.49 7.94	0.042	0.717
B 105	6	152	17.2 14.0	25.60 20.83	$4\frac{17}{32}$ $4\frac{3}{8}$	115 111	$\frac{7}{16}$ $\frac{9}{32}$	11.11 7.14	0.049	0.832

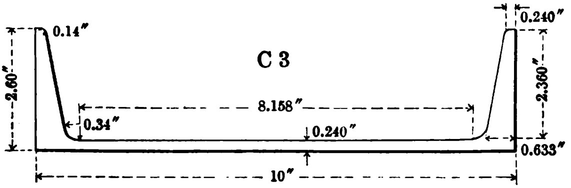
STRUCTURAL CHANNELS



Section Index	Depth of Channel		Weight		Flange Width		Web Thickness	
	Inches	m m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inch	m/m
C 1	15	381	55	81.85	3 13/16	97	.818	20.78
			50	74.41	3 23/32	94	.720	18.29
			45	66.97	3 5/8	92	.622	15.80
			40	59.53	3 17/32	89	.524	13.31
			35	52.09	3 27/64	87	.426	10.82
			33	49.11	3 13/32	86	.400	10.16
C 20	13	330	50	74.41	4 13/32	112	.791	20.09
			45	66.97	4 19/64	109	.678	17.22
			40	59.53	4 3/16	106	.565	14.35
			37	55.06	4 1/8	105	.497	12.62
			35	52.09	4 1/16	104	.452	11.48
			32	47.62	4	102	.375	9.53

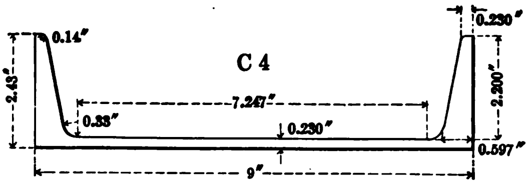
STRUCTURAL CHANNELS.—*Continued*

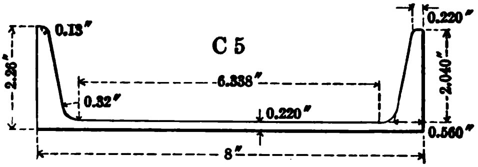


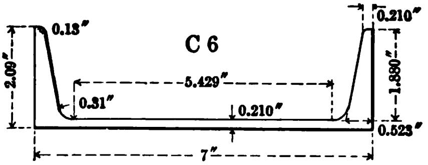


Section Index	Depth of Channel		Weight		Flange Width		Web Thickness	
	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inch	m/m
C 2	12	305	40	59.53	3 27/64	87	.758	19.25
			35	52.09	3 19/64	84	.636	16.15
			30	44.65	3 11/64	81	.513	13.03
			25	37.20	3 3/64	77	.390	9.91
			20½	30.51	2 15/16	75	.280	7.11
C 3	10	254	35	52.09	3 3/16	81	.823	20.90
			30	44.65	3 1/32	77	.676	17.17
			25	37.20	2 57/64	73	.529	13.44
			20	29.76	2 47/64	70	.382	9.70
			15	22.32	2 19/32	66	.240	6.10

Structural Channels.—*Continued*

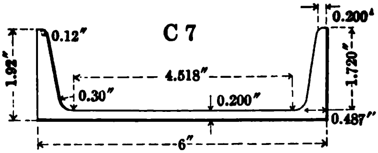


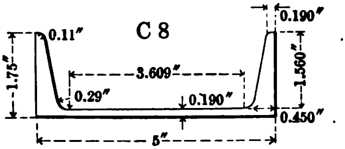


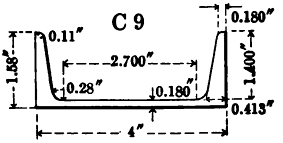


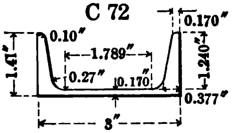
Section Index	Depth of Channel		Weight		Flange Width		Web Thickness	
	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inch	m/m
C 4	9	229	25	37.20	$2\frac{53}{64}$	72	.615	15.62
			20	29.76	$2\frac{21}{32}$	67	.452	11.48
			15	22.32	$2\frac{31}{64}$	63	.288	7.32
			$13\frac{1}{4}$	19.72	$2\frac{7}{16}$	62	.230	5.84
C 5	8	203	$21\frac{1}{4}$	31.62	$2\frac{5}{8}$	67	.582	14.78
			$18\frac{3}{4}$	27.90	$2\frac{17}{32}$	64	.490	12.45
			$16\frac{1}{4}$	24.18	$2\frac{7}{16}$	62	.399	10.13
			$13\frac{3}{4}$	20.46	$2\frac{11}{32}$	60	.307	7.80
			$11\frac{1}{4}$	16.74	$2\frac{17}{64}$	57	.220	5.59
C 6	7	178	$19\frac{3}{4}$	29.39	$2\frac{33}{64}$	64	.633	16.08
			$17\frac{1}{4}$	25.67	$2\frac{13}{32}$	61	528	13.41
			$14\frac{3}{4}$	21.95	$2\frac{19}{64}$	58	.423	10.74
			$12\frac{1}{4}$	18.23	$2\frac{13}{64}$	56	.318	8.08
			$9\frac{3}{4}$	14.51	$2\frac{3}{32}$	53	.210	5.33

STRUCTURAL CHANNELS.—*Continued*







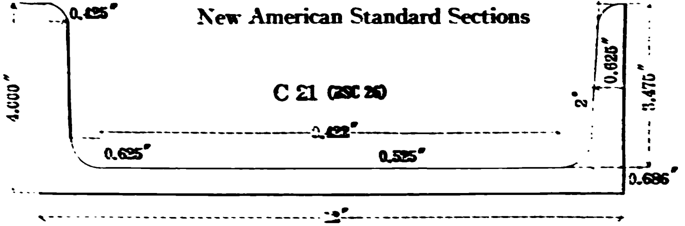


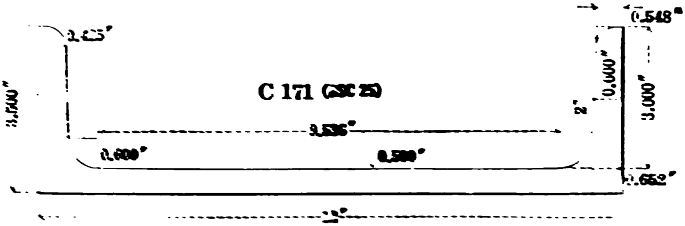
Section Index	Depth of Channel		Weight		Flange Width		Web Thickness	
	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inch	m/m
C 7	6	152	15½	23.07	2 9/32	58	.563	14.30
			13	19.35	2 5/32	55	.440	11.18
			10½	15.63	2 1/32	52	.318	8.08
			8	11.91	1 29/32	49	.200	5.08
C 8	5	127	11½	17.11	2 1/32	52	.477	12.12
			9	13.39	1 29/32	48	.330	8.38
			6½	9.67	1¾	44	.190	4.83
C 9	4	102	7¼	10.79	1 23/32	44	.325	8.26
			6¼	9.30	1 21/32	42	.252	6.40
			5¼	7.81	1 19/32	40	.180	4.57
C 72	3	76	6	8.93	1 19/32	41	.362	9.19
			5	7.44	1½	38	.264	6.71
			4	5.95	1 13/32	36	.170	4.32

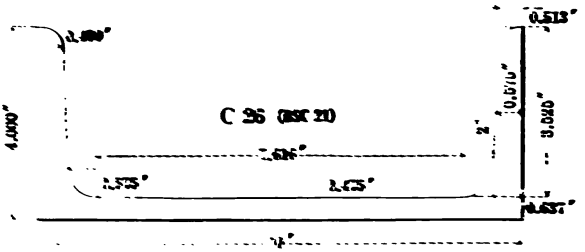
For smaller sizes of Channels, see pages 146 to 152.

SHIP BUILDING CHANNELS

New American Standard Sections



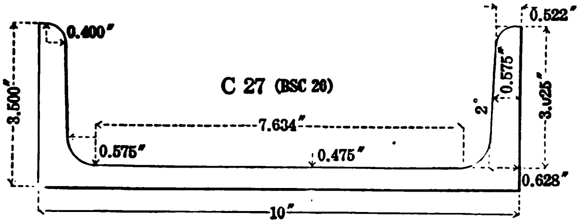


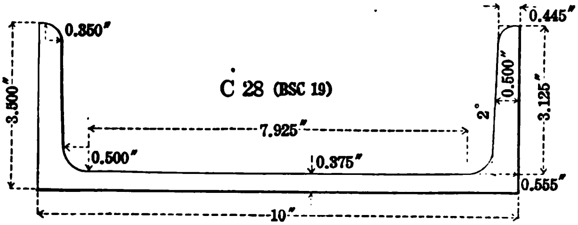


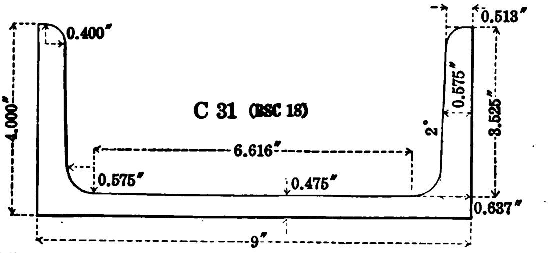
Section Index	Depth of Channel		Weight		Flange Width		Web Thickness	
	inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	inch	m/m
[illegible]	[illegible]	305	[illegible]	[illegible]	[illegible]	[illegible]	0.725	18.42
			[illegible]	[illegible]	[illegible]	[illegible]	0.625	15.88
			[illegible]	[illegible]	**4**	**102**	**0.525**	**13.04**
			[illegible]	[illegible]	[illegible]	[illegible]	0.475	12.07
[illegible]	[illegible]	305	[illegible]	[illegible]	[illegible]	[illegible]	0.700	17.78
			[illegible]	[illegible]	[illegible]	[illegible]	0.600	15.24
			[illegible]	[illegible]	[illegible]	**90**	**0.500**	**12.70**
			[illegible]	[illegible]	[illegible]	88	0.450	11.43
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.675	17.15
			[illegible]	[illegible]	[illegible]	[illegible]	0.575	14.61
			[illegible]	[illegible]	**4**	**102**	**0.475**	**12.07**
			[illegible]	[illegible]	[illegible]	[illegible]	0.425	10.80

Dimensions and Weights of British Standard Sections are indicated in **bold type, see notes on page** [illegible]

SHIP BUILDING CHANNELS.—*Continued*
New American Standard Sections.—*Continued*





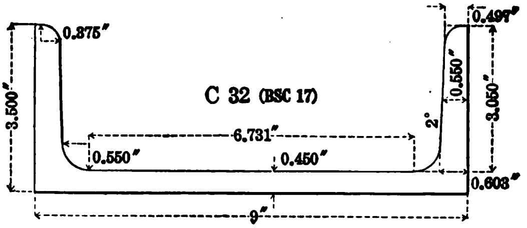


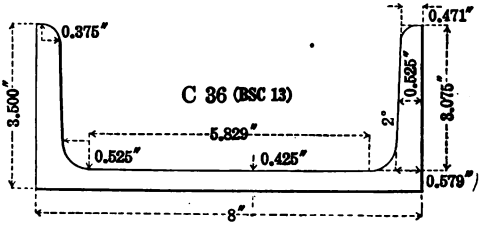
Section Index	Depth of Channel		Weight		Flange Width		Web Thickness	
	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inch	m/m
C 27 (BSC 20)	10	254	34.8	51.79	3 45/64	94	0.675	17.15
			31.4	46.73	3 19/32	91	0.575	14.61
			28.0	**41.67**	**3½**	**89**	**0.475**	**12.07**
			26.3	39.14	3 29/64	88	0.425	10.80
			24.6	36.61	3 13/32	86	0.375	9.53
C 28 (BSC 19)	10	254	25.1	37.35	3 35/64	90	0.425	10.80
			23.4	**34.82**	**3½**	**89**	**0.375**	**9.53**
			21.7	32.29	3 29/64	88	0.325	8.26
C 31 (BSC 18)	9	229	34.5	51.34	4 13/64	107	0.675	17.15
			31.4	46.73	4 3/32	104	0.575	14.61
			28.4	**42.26**	**4**	**102**	**0.475**	**12.07**
			26.8	39.88	3 61/64	100	0.425	10.80

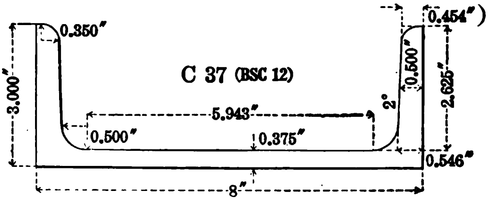
Dimensions and Weights of British Standard Sections are indicated in **bold type**, see notes on *page 563.*

SHIP BUILDING CHANNELS.—*Continued*

New American Standard Sections.—*Continued*





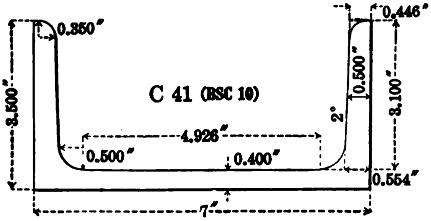


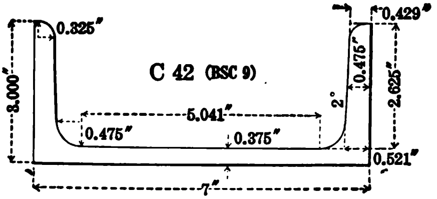
Section Index	Depth of Channel		Weight		Flange Width		Web Thickness	
	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inch	m/m
C 32 (**BSC 17**)	9	229	31.3	46.58	$3\frac{23}{32}$	94	0.650	16.51
			28.3	42.12	$3\frac{19}{32}$	91	0.550	13.97
			25.2	**37.50**	**$3\frac{1}{2}$**	**89**	**0.450**	**11.43**
			23.7	35.27	$3\frac{15}{32}$	88	0.400	10.16
C 36 (**BSC 13**)	8	203	28.0	41.67	$3\frac{23}{32}$	94	0.625	15.88
			25.3	37.65	$3\frac{19}{32}$	91	0.525	13.34
			22.6	**33.63**	**$3\frac{1}{2}$**	**89**	**0.425**	**10.80**
			21.2	31.55	$3\frac{15}{32}$	88	0.375	9.53
C 37 (**BSC 12**)	8	203	25.3	37.65	$3\frac{7}{32}$	82	0.600	15.24
			22.6	33.63	$3\frac{1}{8}$	79	0.500	12.70
			19.9	29.62	$3\frac{1}{32}$	77	0.400	10.16
			19.2	**28.57**	**3**	**76**	**0.375**	**9.53**
			18.5	27.53	$2\frac{31}{32}$	75	0.350	8.89

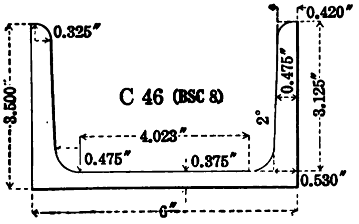
Dimensions and Weights of British Standard Sections are indicated in **bold type**, see notes on *page 563*.

Ship Building Channels.—*Continued*

New American Standard Sections.—*Continued*





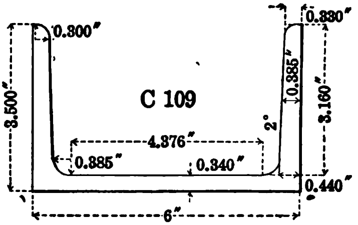


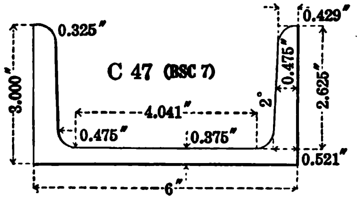
Section Index	Depth of Channel		Weight		Flange Width		Web Thickness	
	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inch	m/m
C 41 **(BSC 10)**	7	178	24.9	37.06	$3\frac{45}{64}$	94	0.600	15.24
			22.5	33.48	$3\frac{19}{32}$	91	0.500	12.70
			20.1	**29.91**	**$3\frac{1}{2}$**	**89**	**0.400**	**10.16**
			18.9	28.13	$3\frac{29}{64}$	88	0.350	8.89
C 42 **(BSC 9)**	**7**	**178**	19.8	29.47	$3\frac{3}{32}$	79	0.475	12.07
			17.4	**25.89**	**3**	**76**	**0.375**	**9.53**
			16.3	24.26	$2\frac{61}{64}$	75	0.325	8.26
C 46 **(BSC 8)**	6	152	21.9	32.59	$3\frac{45}{64}$	94	0.575	14.61
			19.8	29.47	$3\frac{19}{32}$	91	0.475	12.07
			17.8	**26.49**	**$3\frac{1}{2}$**	**89**	**0.375**	**9.53**
			16.8	25.00	$3\frac{29}{64}$	88	0.325	8.26

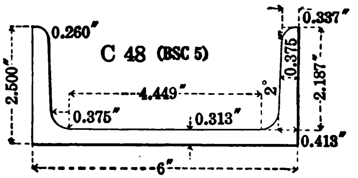
Dimensions and Weights of British Standard Sections are indicated in **bold type**, see notes on page 563.

Ship Building Channels.—*Continued*

New American Standard Sections.—*Continued*



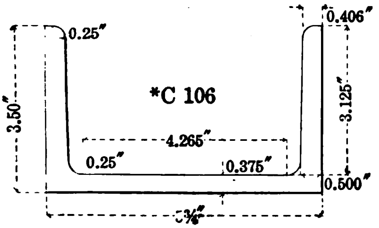


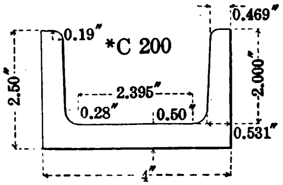


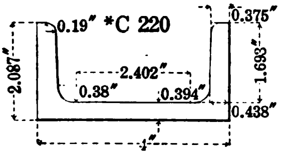
Section Index	Depth of Channel		Weight		Flange Width		Web Thickness	
	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inch	m/m
C 109	6	152	15.3	22.77	3½	89	0.340	8.64
C 47 (BSC 7)	6	152	**16.2** 14.9	**24.11** 22.17	**3** $2\frac{11}{16}$	**76** 75	**0.375** 0.313	**9.53** 7.95
C 48 (BSC 5)	6	152	13.3 **12.0**	19.79 **17.86**	$2\frac{9}{16}$ **2½**	65 **63**	0.375 **0.313**	9.53 **7.95**

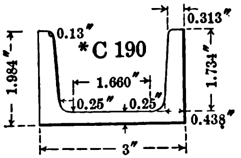
Dimensions and Weights of British Standard Sections are indicated **in bold type**, see notes on page 563.

CAR CHANNELS





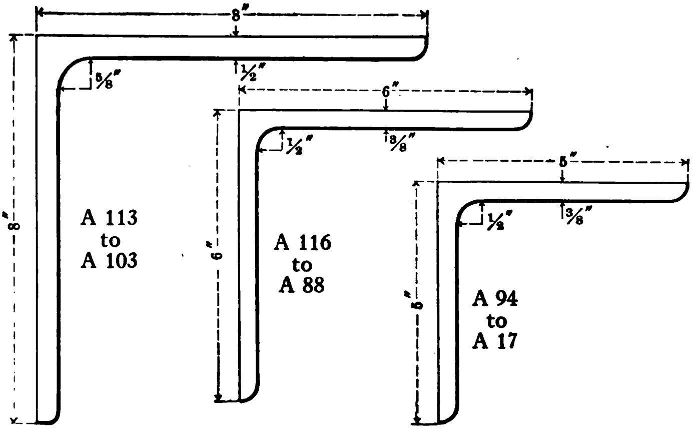




Section Index	Depth of Channel		Weight		Flange Width		Web Thickness	
	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos	Inches	m/m	Inch	m/m
*C 106	5¾	146	17.0	25.30	3½	89	.375	9.53
*C 200	4	102	13.6	20.24	2½	64	.500	12.70
*C 220	4	102	10.1	15.03	2 3/32	53	.394	10.00
*C 190	3	76	7.1	10.60	1 31/32	50	.250	6.35

*Furnished only by special arrangement

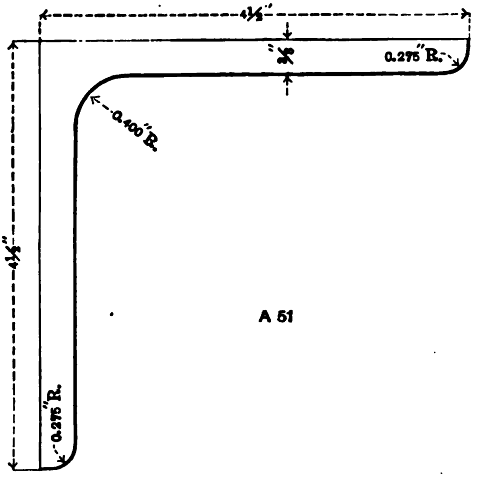
ANGLES WITH EQUAL LEGS—STRUCTURAL SIZES



Section Index	Size		Thickness		Weight	
	Inches	m/m	Inches	m/m	Per Foot, Pounds	Per Meter, Kilos
†A 113	8 x 8	203 x 203	1⅛	28.58	56.9	84.68
†A 112	8 x 8	203 x 203	1 1/16	26.99	54.0	80.36
A 111	8 x 8	203 x 203	1	25.40	51.0	75.90
A 110	8 x 8	203 x 203	15/16	23.81	48.1	71.58
A 109	8 x 8	203 x 203	⅞	22.23	45.0	66.97
A 108	8 x 8	203 x 203	13/16	20.64	42.0	62.50
A 107	8 x 8	203 x 203	¾	19.05	38.9	57.89
A 106	8 x 8	203 x 203	11/16	17.46	35.8	53.28
A 105	8 x 8	203 x 203	⅝	15.88	32.7	48.66
A 104	8 x 8	203 x 203	9/16	14.29	29.6	44.05
A 103	8 x 8	203 x 203	½	12.70	26.4	39.29
A 116	6 x 6	152 x 152	1 1/16	26.99	39.6	58.93
†A 86	6 x 6	152 x 152	1	25.40	37.4	55.66
†A 87	6 x 6	152 x 152	15/16	23.81	35.3	52.53
A 1	6 x 6	152 x 152	⅞	22.23	33.1	49.26
A 2	6 x 6	152 x 152	13/16	20.64	31.0	46.13
A 3	6 x 6	152 x 152	¾	19.05	28.7	42.71
A 4	6 x 6	152 x 152	11/16	17.46	26.5	39.44
A 5	6 x 6	152 x 152	⅝	15.88	24.2	36.01
A 6	6 x 6	152 x 152	9/16	14.29	21.9	32.59
A 7	6 x 6	152 x 152	½	12.70	19.6	29.17
A 8	6 x 6	152 x 152	7/16	11.11	17.2	25.60
A 88	6 x 6	152 x 152	⅜	9.53	14.9	22.17
†A 94	5 x 5	127 x 127	1	25.40	30.6	45.54
†A 95	5 x 5	127 x 127	15/16	23.81	28.9	43.01
A 9	5 x 5	127 x 127	⅞	22.23	27.2	40.48
A 10	5 x 5	127 x 127	13/16	20.64	25.4	37.80
A 11	5 x 5	127 x 127	¾	19.05	23.6	35.12
A 12	5 x 5	127 x 127	11/16	17.46	21.8	32.44
A 13	5 x 5	127 x 127	⅝	15.88	20.0	29.76
A 14	5 x 5	127 x 127	9/16	14.29	18.1	26.94
A 15	5 x 5	127 x 127	½	12.70	16.2	24.11
A 16	5 x 5	127 x 127	7/16	11.11	14.3	21.28
A 17	5 x 5	127 x 127	⅜	9.53	12.3	18.30

†Rolled infrequently

ANGLES WITH EQUAL LEGS—STRUCTURAL SIZES.—*Continued*

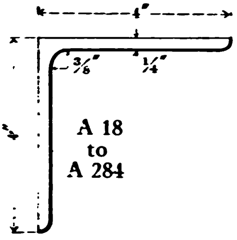


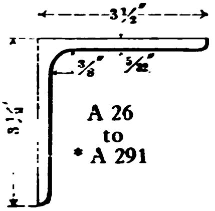
A 51

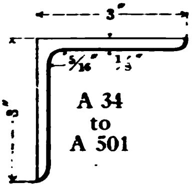
Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
*A 51	4½ x 4½	114 x 114	¾	19.05	21.15	31.48
	4½ x 4½	114 x 114	11/16	17.46	19.40	28.87
	4½ x 4½	114 x 114	⅝	15.88	17.74	26.40
	4½ x 4½	114 x 114	9/16	14.29	16.10	23.96
	4½ x 4½	114 x 114	½	12.70	14.40	21.43
	4½ x 4½	114 x 114	7/16	11.11	12.70	18.90
	4½ x 4½	114 x 114	⅜	9.53	10.95	16.30

*Manufactured by Illinois Steel Company.

ANGLES WITH EQUAL LEGS—STRUCTURAL SIZES.—*Continued*







Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
†A 18	4 x 4	102 x 102	13/16	20.64	19.9	29.61
A 19	4 x 4	102 x 102	3/4	19.05	18.5	27.53
A 20	4 x 4	102 x 102	11/16	17.46	17.1	25.45
A 21	4 x 4	102 x 102	5/8	15.88	15.7	23.36
A 22	4 x 4	102 x 102	9/16	14.29	14.3	21.28
A 23	4 x 4	102 x 102	1/2	12.70	12.8	19.05
A 24	4 x 4	102 x 102	7/16	11.11	11.3	16.82
A 25	4 x 4	102 x 102	3/8	9.53	9.8	14.58
A 90	4 x 4	102 x 102	5/16	7.94	8.2	12.20
†A 284	4 x 4	102 x 102	1/4	6.35	6.6	9.82
†A 26	3½ x 3½	89 x 89	13/16	20.64	17.1	25.45
†A 27	3½ x 3½	89 x 89	3/4	19.05	16.0	23.81
†A 28	3½ x 3½	89 x 89	11/16	17.46	14.8	22.03
A 29	3½ x 3½	89 x 89	5/8	15.88	13.6	20.24
A 30	3½ x 3½	89 x 89	9/16	14.29	12.4	18.45
A 31	3½ x 3½	89 x 89	1/2	12.70	11.1	16.52
A 32	3½ x 3½	89 x 89	7/16	11.11	9.8	14.58
A 33	3½ x 3½	89 x 89	3/8	9.53	8.5	12.65
A 99	3½ x 3½	89 x 89	5/16	7.94	7.2	10.72
A 285	3½ x 3½	89 x 89	1/4	6.35	5.8	8.63
*A 288	3½ x 3½	89 x 89	3/16	4.76	4.4	6.55
*A 291	3½ x 3½	89 x 89	5/32	3.97	3.6	5.42
†A 34	3 x 3	76 x 76	5/8	15.88	11.5	17.11
†A 35	3 x 3	76 x 76	9/16	14.29	10.4	15.48
A 36	3 x 3	76 x 76	1/2	12.70	9.4	13.99
A 37	3 x 3	76 x 76	7/16	11.11	8.3	12.35
A 38	3 x 3	76 x 76	3/8	9.53	7.2	10.72
A 39	3 x 3	76 x 76	5/16	7.94	6.1	9.08
A 40	3 x 3	76 x 76	1/4	6.35	4.9	7.29
A 500	3 x 3	76 x 76	3/16	4.76	3.7	5.52
A 501	3 x 3	76 x 76	1/8	3.18	2.5	3.72

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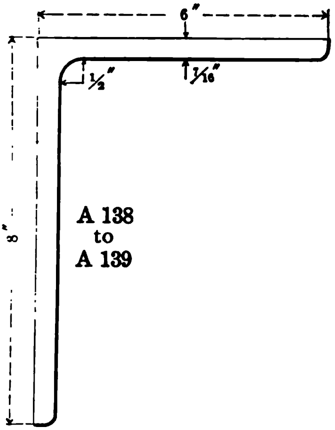
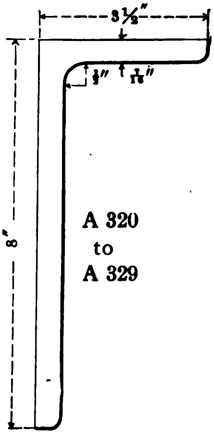
*Furnished only by special arrangement.

†Rolled infrequently.

For smaller sizes of angles with Equal Legs, see pages 153 and 154.

ANGLES WITH UNEQUAL LEGS— STRUCTURAL SIZES

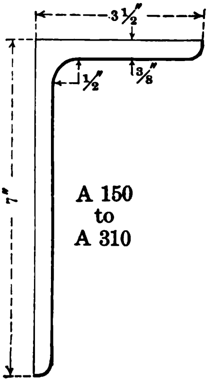


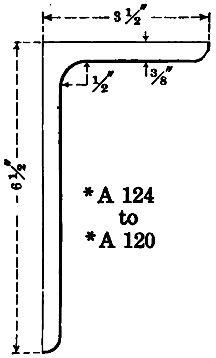


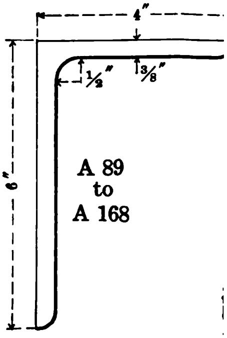
Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
†A 138	8 x 6	203 x 152	1	25.40	44.2	65.78
†A 137	8 x 6	203 x 152	15/16	23.81	41.7	62.06
†A 136	8 x 6	203 x 152	7/8	22.23	39.1	58.19
†A 135	8 x 6	203 x 152	13/16	20.64	36.5	54.32
†A 134	8 x 6	203 x 152	3/4	19.05	33.8	50.30
†A 133	8 x 6	203 x 152	11/16	17.46	31.2	46.43
†A 132	8 x 6	203 x 152	5/8	15.88	28.5	42.41
†A 131	8 x 6	203 x 152	9/16	14.29	25.7	38.25
†A 130	8 x 6	203 x 152	1/2	12.70	23.0	34.23
†A 139	8 x 6	203 x 152	7/16	11.11	20.2	30.06
†A 320	8 x 3½	203 x 89	1	25.40	35.7	53.13
†A 321	8 x 3½	203 x 89	15/16	23.81	33.7	50.15
†A 322	8 x 3½	203 x 89	7/8	22.23	31.7	47.18
†A 323	8 x 3½	203 x 89	13/16	20.64	29.6	44.05
†A 324	8 x 3½	203 x 89	3/4	19.05	27.5	40.93
†A 325	8 x 3½	203 x 89	11/16	17.46	25.3	37.65
†A 326	8 x 3½	203 x 89	5/8	15.88	23.2	34.53
†A 327	8 x 3½	203 x 89	9/16	14.29	21.0	31.25
†A 328	8 x 3½	203 x 89	1/2	12.70	18.7	27.83
†A 329	8 x 3½	203 x 89	7/16	11.11	16.5	24.56

†Rolled infrequently.

ANGLES WITH UNEQUAL LEGS—STRUCTURAL SIZES.—*Continued*



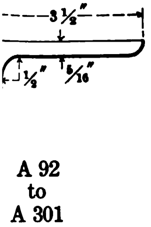


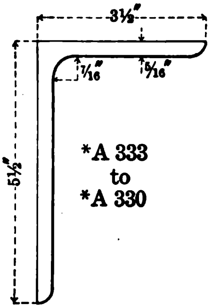


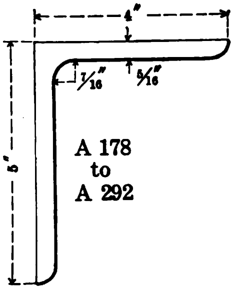
Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
†A 150	7 x 3½	178 x 89	1	25.40	32.3	48.07
†A 151	7 x 3½	178 x 89	15/16	23.81	30.5	45.39
†A 152	7 x 3½	178 x 89	⅞	22.23	28.7	42.71
†A 153	7 x 3½	178 x 89	13/16	20.64	26.8	39.88
†A 154	7 x 3½	178 x 89	¾	19.05	24.9	37.06
†A 155	7 x 3½	178 x 89	11/16	17.46	23.0	34.23
†A 156	7 x 3½	178 x 89	⅝	15.88	21.0	31.25
†A 157	7 x 3½	178 x 89	9/16	14.29	19.1	28.42
†A 158	7 x 3½	178 x 89	½	12.70	17.0	25.30
†A 159	7 x 3½	178 x 89	7/16	11.11	15.0	22.32
†A 310	7 x 3½	178 x 89	⅜	9.53	13.0	19.35
*A 124	6½ x 3½	165 x 89	⅝	15.88	20.0	29.76
*A 123	6½ x 3½	165 x 89	9/16	14.29	18.1	26.94
*A 122	6½ x 3½	165 x 89	½	12.70	16.2	24.11
*A 121	6½ x 3½	165 x 89	7/16	11.11	14.3	21.28
*A 120	6½ x 3½	165 x 89	⅜	9.53	12.3	18.30
†A 89	6 x 4	152 x 102	1	25.40	30.6	45.54
†A 91	6 x 4	152 x 102	15/16	23.81	28.9	43.01
A 160	6 x 4	152 x 102	⅞	22.23	27.2	40.48
A 161	6 x 4	152 x 102	13/16	20.64	25.4	37.80
A 162	6 x 4	152 x 102	¾	19.05	23.6	35.12
A 163	6 x 4	152 x 102	11/16	17.46	21.8	32.44
A 164	6 x 4	152 x 102	⅝	15.88	20.0	29.76
A 165	6 x 4	152 x 102	9/16	14.29	18.1	26.94
A 166	6 x 4	152 x 102	½	12.70	16.2	24.11
A 167	6 x 4	152 x 102	7/16	11.11	14.3	21.28
A 168	6 x 4	152 x 102	⅜	9.53	12.3	18.30

*Furnished only by special arrangement.
†Rolled infrequently.

ANGLES WITH UNEQUAL LEGS—STRUCTURAL SIZES.—*Continued*







tion dex	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
92	6 x 3½	152 x 89	1	25.40	28.9	43.01
93	6 x 3½	152 x 89	15/16	23.81	27.3	40.63
69	6 x 3½	152 x 89	7/8	22.23	25.7	38.25
70	6 x 3½	152 x 89	13/16	20.64	24.0	35.72
71	6 x 3½	152 x 89	3/4	19.05	22.4	33.33
72	6 x 3½	152 x 89	11/16	17.46	20.6	30.66
73	6 x 3½	152 x 89	5/8	15.88	18.9	28.13
74	6 x 3½	152 x 89	9/16	14.29	17.1	25.45
75	6 x 3½	152 x 89	1/2	12.70	15.3	22.77
76	6 x 3½	152 x 89	7/16	11.11	13.5	20.09
77	6 x 3½	152 x 89	3/8	9.53	11.7	17.41
01	6 x 3½	152 x 89	5/16	7.94	9.8	14.58
33	5½ x 3½	140 x 89	½	12.70	14.5	21.58
32	5½ x 3½	140 x 89	7/16	11.11	12.8	19.05
31	5½ x 3½	140 x 89	⅜	9.53	11.0	16.37
30	5½ x 3½	140 x 89	5/16	7.94	9.3	13.84
78	5 x 4	127 x 102	7/8	22.23	24.2	36.01
79	5 x 4	127 x 102	13/16	20.64	22.7	33.78
80	5 x 4	127 x 102	3/4	19.05	21.1	31.40
81	5 x 4	127 x 102	11/16	17.46	19.5	29.02
82	5 x 4	127 x 102	5/8	15.88	17.8	26.49
83	5 x 4	127 x 102	9/16	14.29	16.2	24.11
84	5 x 4	127 x 102	1/2	12.70	14.5	21.58
85	5 x 4	127 x 102	7/16	11.11	12.8	19.05
86	5 x 4	127 x 102	3/8	9.53	11.0	16.37
92	5 x 4	127 x 102	5/16	7.94	9.3	13.84

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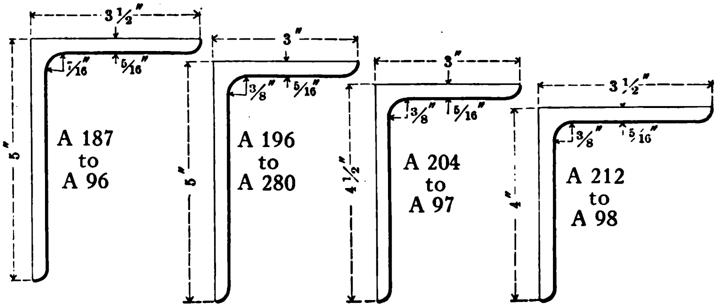
ed infrequently.

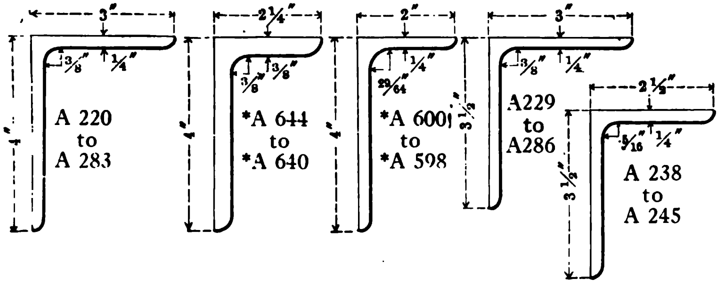
ANGLES WITH UNEQUAL LEGS—STRUCTURAL SIZES.—*Continued*



Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
†A 187	5 x 3½	127 x 89	⅞	22.23	22.7	33.78
†A 188	5 x 3½	127 x 89	13/16	20.64	21.3	31.70
A 189	5 x 3½	127 x 89	¾	19.05	19.8	29.47
A 190	5 x 3½	127 x 89	11/16	17.46	18.3	27.23
A 191	5 x 3½	127 x 89	⅝	15.88	16.8	25.00
A 192	5 x 3½	127 x 89	9/16	14.29	15.2	22.62
A 193	5 x 3½	127 x 89	½	12.70	13.6	20.24
A 194	5 x 3½	127 x 89	7/16	11.11	12.0	17.86
A 195	5 x 3½	127 x 89	⅜	9.53	10.4	15.48
A 96	5 x 3½	127 x 89	5/16	7.94	8.7	12.95
†A 196	5 x 3	127 x 76	13/16	20.64	19.9	29.61
†A 197	5 x 3	127 x 76	¾	19.05	18.5	27.53
A 198	5 x 3	127 x 76	11/16	17.46	17.1	25.45
A 199	5 x 3	127 x 76	⅝	15.88	15.7	23.36
A 200	5 x 3	127 x 76	9/16	14.29	14.3	21.28
A 201	5 x 3	127 x 76	½	12.70	12.8	19.05
A 202	5 x 3	127 x 76	7/16	11.11	11.3	16.82
A 203	5 x 3	127 x 76	⅜	9.53	9.8	14.58
A 280	5 x 3	127 x 76	5/16	7.94	8.2	12.20
†A 204	4½ x 3	114 x 76	13/16	20.64	18.5	27.53
†A 205	4½ x 3	114 x 76	¾	19.05	17.3	25.75
†A 206	4½ x 3	114 x 76	11/16	17.46	16.0	23.81
†A 207	4½ x 3	114 x 76	⅝	15.88	14.7	21.88
†A 208	4½ x 3	114 x 76	9/16	14.29	13.3	19.79
†A 209	4½ x 3	114 x 76	½	12.70	11.9	17.71
†A 210	4½ x 3	114 x 76	7/16	11.11	10.6	15.77
†A 211	4½ x 3	114 x 76	⅜	9.53	9.1	13.54
†A 97	4½ x 3	114 x 76	5/16	7.94	7.7	11.46
†A 212	4 x 3½	102 x 89	13/16	20.64	18.5	27.53
†A 213	4 x 3½	102 x 89	¾	19.05	17.3	25.75
†A 214	4 x 3½	102 x 89	11/16	17.46	16.0	23.81
†A 215	4 x 3½	102 x 89	⅝	15.88	14.7	21.88
†A 216	4 x 3½	102 x 89	9/16	14.29	13.3	19.79
†A 217	4 x 3½	102 x 89	½	12.70	11.9	17.71
†A 218	4 x 3½	102 x 89	7/16	11.11	10.6	15.77
†A 219	4 x 3½	102 x 89	⅜	9.53	9.1	13.54
†A 98	4 x 3½	102 x 89	5/16	7.94	7.7	11.46

†*Rolled* infrequently.

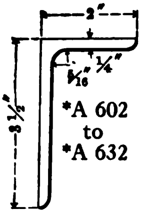
ANGLES WITH UNEQUAL LEGS—STRUCTURAL SIZES.—*Continued*

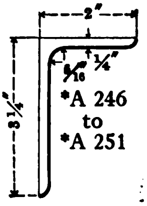


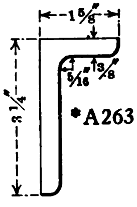
Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
†A 220	4 x 3	102 x 76	13/16	20.64	17.1	25.45
†A 221	4 x 3	102 x 76	3/4	19.05	16.0	23.81
A 222	4 x 3	102 x 76	11/16	17.46	14.8	22.03
A 223	4 x 3	102 x 76	5/8	15.88	13.6	20.24
A 224	4 x 3	102 x 76	9/16	14.29	12.4	18.45
A 225	4 x 3	102 x 76	1/2	12.70	11.1	16.52
A 226	4 x 3	102 x 76	7/16	11.11	9.8	14.58
A 227	4 x 3	102 x 76	3/8	9.53	8.5	12.65
A 228	4 x 3	102 x 76	5/16	7.94	7.2	10.72
†A 283	4 x 3	102 x 76	1/4	6.35	5.8	8.63
*A 644	4 x 2½	102 x 57	5/8	15.88	12.0	17.86
*A 643	4 x 2½	102 x 57	9/16	14.29	10.9	16.22
*A 642	4 x 2½	102 x 57	1/2	12.70	9.8	14.58
*A 641	4 x 2½	102 x 57	7/16	11.11	8.7	12.95
*A 640	4 x 2½	102 x 57	3/8	9.53	7.5	11.16
*A 600	4 x 2	102 x 51	3/8	9.53	7.2	10.71
*A 601	4 x 2	102 x 51	5/16	7.94	6.1	9.08
*A 598	4 x 2	102 x 51	1/4	6.35	4.9	7.29
†A 229	3½ x 3	89 x 76	13/16	20.64	15.8	23.51
†A 230	3½ x 3	89 x 76	3/4	19.05	14.7	21.88
†A 231	3½ x 3	89 x 76	11/16	17.46	13.6	20.24
†A 232	3½ x 3	89 x 76	5/8	15.88	12.5	18.60
A 233	3½ x 3	89 x 76	9/16	14.29	11.4	16.97
A 234	3½ x 3	89 x 76	1/2	12.70	10.2	15.18
A 235	3½ x 3	89 x 76	7/16	11.11	9.1	13.54
A 236	3½ x 3	89 x 76	3/8	9.53	7.9	11.76
A 237	3½ x 3	89 x 76	5/16	7.94	6.6	9.82
A 286	3½ x 3	89 x 76	1/4	6.35	5.4	8.04
†A 238	3½ x 2½	89 x 64	11/16	17.46	12.5	18.60
†A 239	3½ x 2½	89 x 64	5/8	15.88	11.5	17.11
†A 240	3½ x 2½	89 x 64	9/16	14.29	10.4	15.48
A 241	3½ x 2½	89 x 64	1/2	12.70	9.4	13.99
A 242	3½ x 2½	89 x 64	7/16	11.11	8.3	12.35
A 243	3½ x 2½	89 x 64	3/8	9.53	7.2	10.72
A 244	3½ x 2½	89 x 64	5/16	7.94	6.1	9.08
A 245	3½ x 2½	89 x 64	1/4	6.35	4.9	7.29

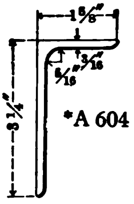
*Furnished only by special arrangement. †Rolled infrequently.

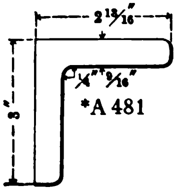
Angles with Unequal Legs—Structural Sizes.—*Continued*

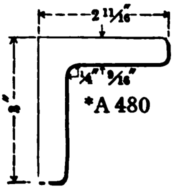


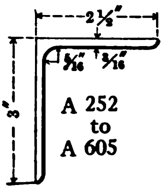


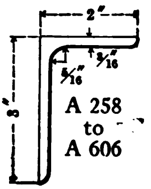








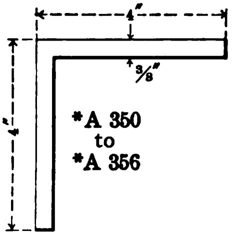


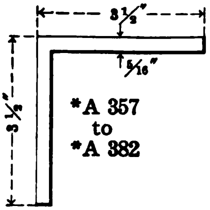


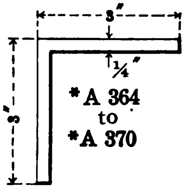
Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
*A 602	3½ x 2	89 x 51	⅜	9.53	6.6	9.82
*A 603	3½ x 2	89 x 51	5/16	7.94	5.6	8.33
*A 632	3½ x 2	89 x 51	¼	6.35	4.5	6.70
*A 246	3¼ x 2	83 x 51	9/16	14.29	9.0	13.39
*A 247	3¼ x 2	83 x 51	½	12.70	8.1	12.05
*A 248	3¼ x 2	83 x 51	7/16	11.11	7.2	10.72
*A 249	3¼ x 2	83 x 51	⅜	9.53	6.3	9.38
*A 250	3¼ x 2	83 x 51	5/16	7.94	5.3	7.89
*A 251	3¼ x 2	83 x 51	¼	6.35	4.3	6.40
*A 263	3¼ x 1⅝	83 x 41	⅜	9.53	5.8	8.63
‡*A 604	3¼ x 1⅝	83 x 41	3/16	4.76	2.99	4.45
*A 481	3 x 2 13/16	76 x 71	9/16	14.29	10.1	15.03
*A 480	3 x 2 11/16	76 x 68	9/16	14.29	9.8	14.58
†A 252	3 x 2½	76 x 64	9/16	14.29	9.5	14.14
†A 253	3 x 2½	76 x 64	½	12.70	8.5	12.65
A 254	3 x 2½	76 x 64	7/16	11.11	7.6	11.31
A 255	3 x 2½	76 x 64	⅜	9.53	6.6	9.82
A 256	3 x 2½	76 x 64	5/16	7.94	5.6	8.33
A 257	3 x 2½	76 x 64	¼	6.35	4.5	6.70
‡A 605	3 x 2½	76 x 64	3/16	4.76	3.39	5.04
†A 258	3 x 2	76 x 51	½	12.70	7.7	11.46
†A 259	3 x 2	76 x 51	7/16	11.11	6.8	10.12
†A 260	3 x 2	76 x 51	⅜	9.53	5.9	8.78
†A 261	3 x 2	76 x 51	5/16	7.94	5.0	7.44
†A 262	3 x 2	76 x 51	¼	6.35	4.1	6.10
‡A 606	3 x 2	76 x 51	3/16	4.76	3.07	4.57

*Furnished only by special arrangement. †Rolled infrequently.
‡*These* are "Bar Mill Sizes," sold at the Base Price of Bars plus bar extras.
For smaller sizes of Angles with Unequal Legs, see pages 155 to 157.

SQUARE ROOT ANGLES—STRUCTURAL SIZES



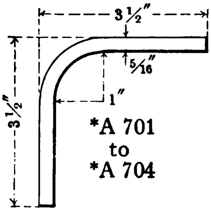


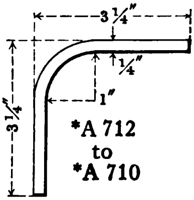


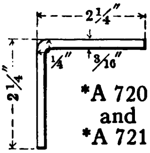
Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
*A 350	4 x 4	102 x 102	¾	19.05	18.5	27.53
*A 351	4 x 4	102 x 102	11/16	17.46	17.1	25.45
*A 352	4 x 4	102 x 102	⅝	15.88	15.7	23.36
*A 353	4 x 4	102 x 102	9/16	14.29	14.3	21.28
*A 354	4 x 4	102 x 102	½	12.70	12.8	19.05
*A 355	4 x 4	102 x 102	7/16	11.11	11.3	16.82
*A 356	4 x 4	102 x 102	⅜	9.53	9.8	14.58
*A 357	3½ x 3½	89 x 89	¾	19.05	16.0	23.81
*A 358	3½ x 3½	89 x 89	11/16	17.46	14.8	22.03
*A 359	3½ x 3½	89 x 89	⅝	15.88	13.6	20.24
*A 360	3½ x 3½	89 x 89	9/16	14.29	12.4	18.45
*A 361	3½ x 3½	89 x 89	½	12.70	11.1	16.52
*A 362	3½ x 3½	89 x 89	7/16	11.11	9.8	14.58
*A 363	3½ x 3½	89 x 89	⅜	9.53	8.5	12.65
*A 382	3½ x 3½	89 x 89	5/16	7.94	7.2	10.72
*A 364	3 x 3	76 x 76	⅝	15.88	11.5	17.11
*A 365	3 x 3	76 x 76	9/16	14.29	10.4	15.48
*A 366	3 x 3	76 x 76	½	12.70	9.4	13.99
*A 367	3 x 3	76 x 76	7/16	11.11	8.3	12.35
*A 368	3 x 3	76 x 76	⅜	9.53	7.2	10.72
*A 369	3 x 3	76 x 76	5/16	7.94	6.1	9.08
*A 370	3 x 3	76 x 76	¼	6.35	4.9	7.29

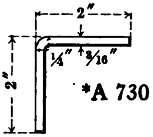
***Furnished only by special** arrangement. **Rolled infrequently.**
For smaller sizes of Square Root Angles see pages 158 and 159.

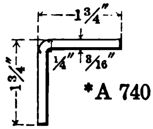
ROUND BACK ANGLES

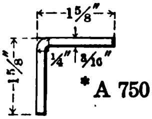


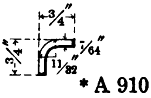










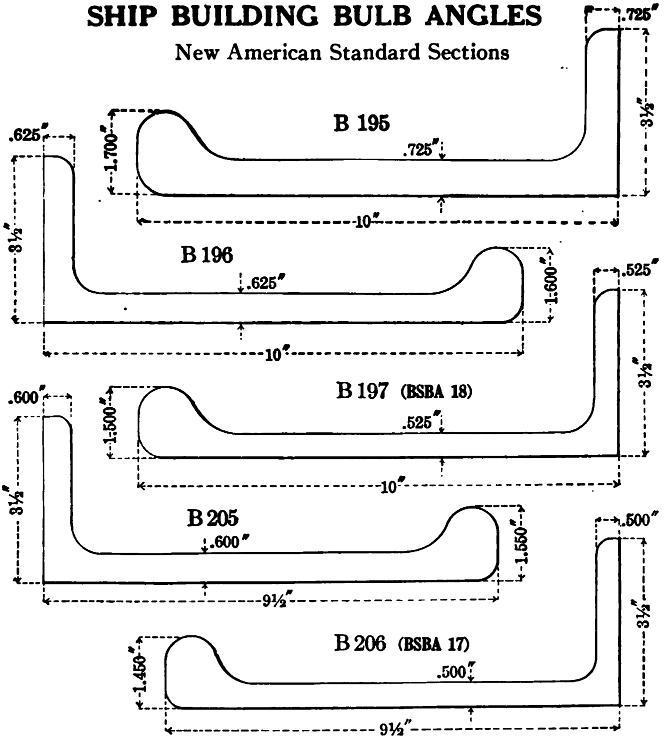


Section Index	Size		Thickness		Weight	
	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
*A 701	3½ x 3½	89 x 89	9/16	14.29	11.3	16.82
*A 702	3½ x 3½	89 x 89	½	12.70	10.2	15.18
*A 703	3½ x 3½	89 x 89	7/16	11.11	9.0	13.39
*A 700	3½ x 3½	89 x 89	⅜	9.53	7.8	11.61
*A 704	3½ x 3½	89 x 89	5/16	7.94	6.6	9.82
*A 712	3¼ x 3¼	83 x 83	⅜	9.53	7.2	10.72
*A 711	3¼ x 3¼	83 x 83	5/16	7.94	6.1	9.08
*A 710	3¼ x 3¼	83 x 83	¼	6.35	4.9	7.29
‡*A 720	2¼ x 2¼	57 x 57	¼	6.35	3.48	5.18
‡*A 721	2¼ x 2¼	57 x 57	3/16	4.76	2.66	3.96
‡*A 730	2 x 2	51 x 51	3/16	4.76	2.34	3.48
‡*A 740	1¾ x 1¾	44 x 44	3/16	4.76	2.02	3.01
‡*A 750	1⅝ x 1⅝	41 x 41	3/16	4.76	1.86	2.77
‡*A 910	¾ x ¾	19 x 19	7/64	2.78	0.48	0.71

******Furnished* **only by special arrangement.**
‡***Bar Mill* sizes sold at base** price for Bars plus bar extras.

SHIP BUILDING BULB ANGLES

New American Standard Sections

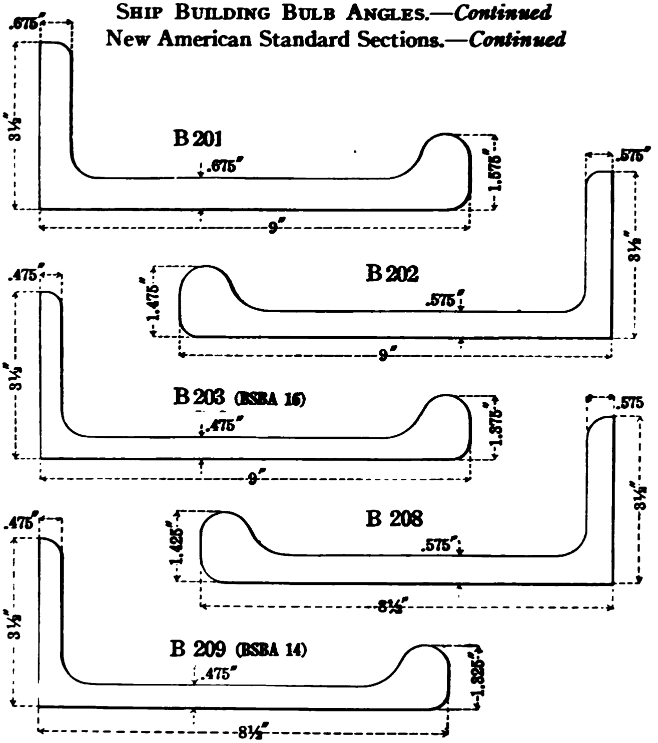


Section Index	Depth		Flange Width		Web Thickness		Weight	
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
B 195	10	254	3½	89	0.725 0.675	18.40 17.15	35.2 33.2	52.38 49.41
B 196	10	254	3½	89	0.625 0.575	15.88 14.61	31.1 29.1	46.28 43.31
B 197 **(BSBA 18)**	10	254	3½	89	**0.525** 0.475	**13.34** 12.07	**26.9** 24.9	**40.03** 37.06
B 205	9½	241	3½	89	0.600 0.550	15.24 13.97	28.8 26.9	42.86 40.03
B 206 **(BSBA 17)**	9½	241	3½	89	**0.500** 0.450	**12.70** 11.43	**24.7** 22.8	**36.76** 33.93

Dimensions and Weights of British Standard Sections are indicated in **bold type,** see notes on page 563.

SHIP BUILDING BULB ANGLES.—*Continued*

New American Standard Sections.—*Continued*

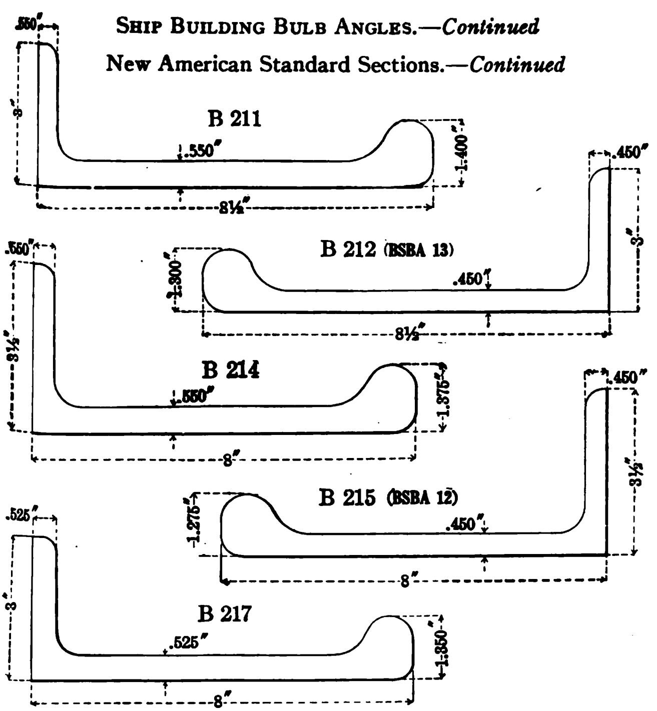


Section Index	Depth		Flange Width		Web Thickness		Weight	
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
B 201	9	229	3½	89	0.675 0.625	17.15 15.88	30.4 28.6	45.24 42.56
B 202	9	229	3½	89	0.575 0.525	14.61 13.34	26.6 24.8	39.59 36.91
B 203 **(BSBA 16)**	9	229	3½	89	**0.475** 0.425	**12.07** 10.80	**22.7** 20.9	**33.78** 31.10
B 208	8½	216	3½	89	0.575 0.525	14.61 13.34	25.3 23.5	37.65 34.97
B 209 **(BSBA 14)**	8½	216	3½	89	**0.475** 0.425	**12.07** 10.80	**21.6** 19.8	**32.15** 29.47

Dimensions and Weights of British Standard Sections are indicated in **bold type**, see notes on page 563.

SHIP BUILDING BULB ANGLES.—*Continued*

New American Standard Sections.—*Continued*

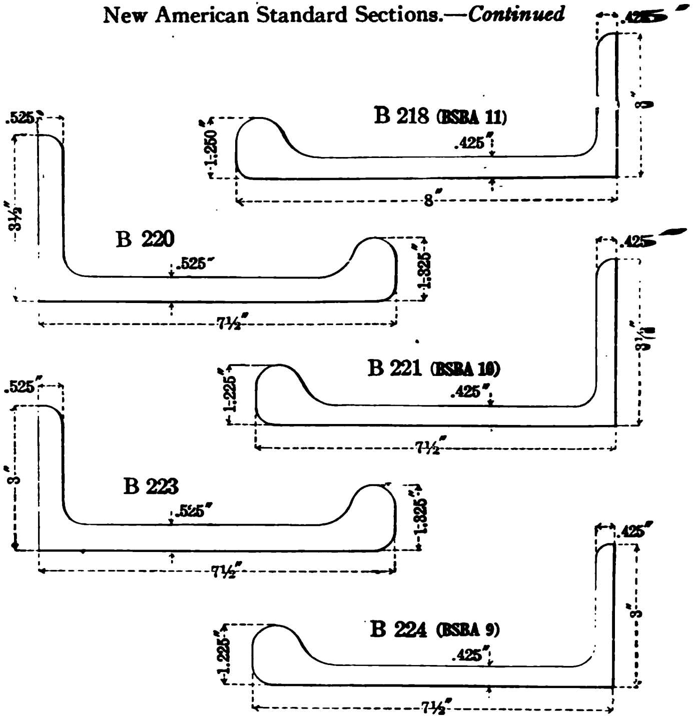


ection ndex	Depth		Flange Width		Web Thickness		Weight	
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
211	8½	216	3	76	0.550 0.500	13.97 12.70	23.4 21.7	34.82 32.29
212 BA 13)	8½	216	3	76	**0.450** 0.400	**11.43** 10.16	**19.8** 18.1	**29.47** 26.94
214	8	203	3½	89	0.550 0.500	13.97 12.70	23.2 21.6	34.53 32.15
215 BA 12)	8	203	3½	89	**0.450** 0.400	**11.43** 10.16	**19.6** 18.0	**29.17** 26.79
217	8	203	3	76	0.575 0.525	14.61 13.34	23.1 21.4	34.38 31.85

imensions and Weights of British Standard Sections are indicated in **bold type, see notes age 563.**

SHIP BUILDING BULB ANGLES.—*Continued*

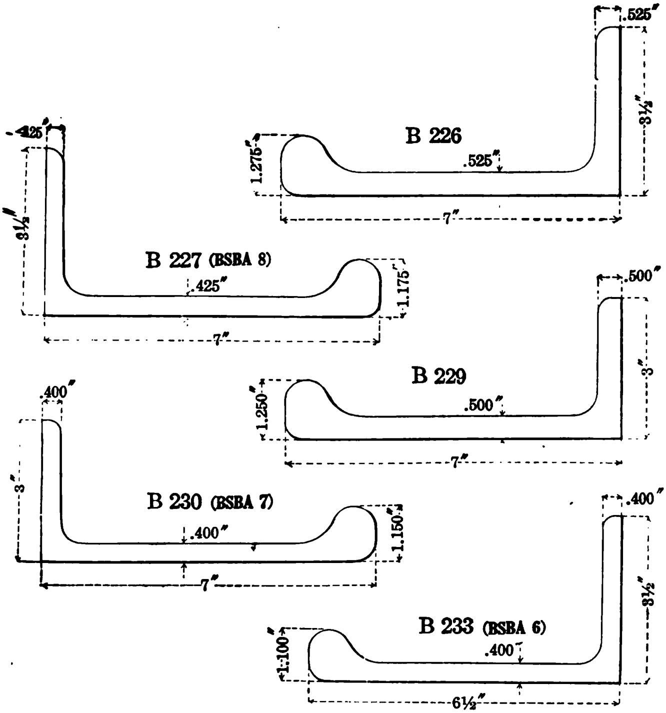
New American Standard Sections.—*Continued*



Section Index	Depth		Flange Width		Web Thickness		Weight	
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
B 218 **(BSBA 11)**	8	203	3	76	0.475 **0.425**	12.07 **10.80**	19.6 **18.0**	29.17 **26.79**
B 220	7½	191	3½	89	0.575 0.525	14.61 13.34	22.8 21.2	33.93 31.55
B 221 **(BSBA 10)**	7½	191	3½	89	0.475 **0.425**	12.07 **10.80**	19.4 **17.8**	28.87 **26.49**
B 223	7½	191	3	76	0.525 0.475	13.34 12.07	20.3 18.8	30.21 27.98
B 224 **(BSBA 9)**	7½	191	3	76	**0.425** 0.375	**10.80** 9.53	**17.1** 15.6	**25.45** 23.22

Dimensions and Weights of British Standard Sections are indicated **in bold type, see notes** on page 563.

SHIP BUILDING BULB ANGLES.—*Continued*
New American Standard Sections.—*Continued*

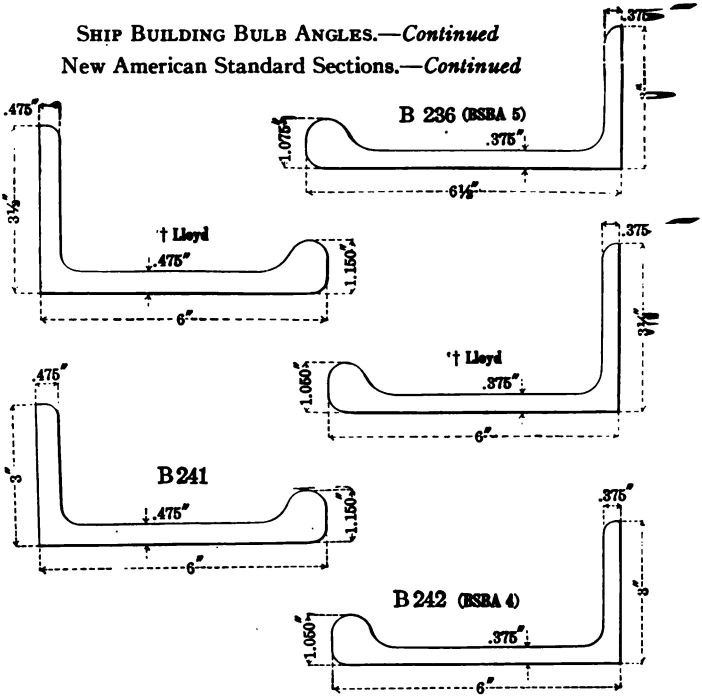


ction ndex	Depth		Flange Width		Web Thickness		Weight	
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
226	7	178	3½	89	0.525 0.475	13.34 12.07	20.0 18.6	29.76 27.68
227 BA 8)	7	178	3½	89	**0.425** 0.375	**10.80** 9.53	**16.8** 15.3	**25.00** 22.77
229	7	178	3	76	0.500 0.450	12.70 11.43	18.4 16.9	27.38 25.15
230 BA 7)	7	178	3	76	**0.400** 0.350	**10.16** 8.89	**15.3** 13.9	**22.77** 20.69
233 BA 6)	6½	165	3½	89	**0.400** 0.350	**10.16** 8.89	**15.0** 13.6	**22.32** 20.24

mensions and Weights of British Standard Sections are indicated in **bold type**, see notes age 563.

SHIP BUILDING BULB ANGLES.—*Continued*

New American Standard Sections.—*Continued*

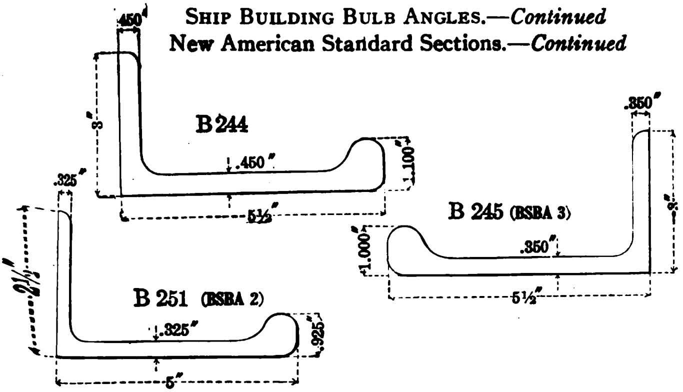


Section Index	Depth		Flange Width		Web Thickness		Weight	
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
B 236 (BSBA 5)	6½	165	3	76	0.425 **0.375** 0.350	10.80 **9.53** 8.89	15.0 **13.6** 12.9	22.32 **20.24** 19.20
†Lloyd	6	152	3½	89	0.475 0.425	12.07 10.80	16.4 14.8	24.41 22.03
†Lloyd	6	152	3½	89	**0.375** 0.350	**9.53** 8.89	**13.4** 12.8	**19.94** 19.05
B 241	6	152	3	76	0.525 0.475	13.34 12.07	16.8 15.6	25.00 23.22
B 242 (BSBA 4)	6	152	3	76	0.425 **0.375** 0.350	10.80 **9.53** 8.89	14.1 **12.8** 12.2	20.98 **19.05** 18.16

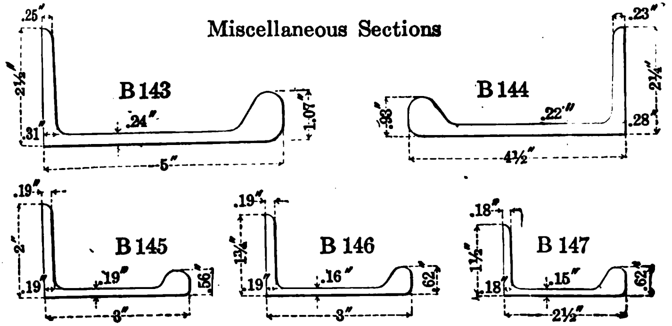
†Rolled by Pencoyd Iron Works (60A).
Dimensions and Weights of British Standard Sections are indicated in **bold type, see notes** on page 563.

SHIP BUILDING BULB ANGLES.—*Continued*

New American Standard Sections.—*Continued*



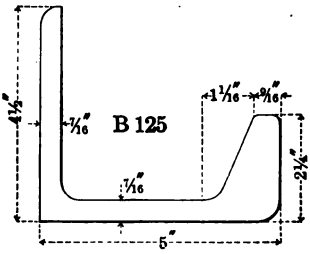
Miscellaneous Sections

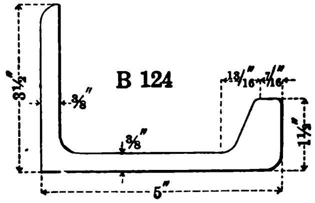


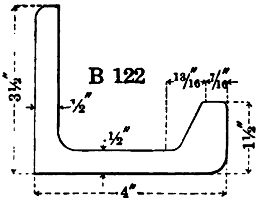
Section Index	Depth		Flange Width		Web Thickness		Weight	
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
B 244	5½	140	3	76	0.500 0.450	12.70 11.43	15.1 13.9	22.47 20.69
B 245 (BSBA 3)	5½	140	3	76	0.400 **0.350** 0.325	10.16 **8.89** 8.26	12.5 **11.3** 10.7	18.60 **16.82** 15.92
B 251 (BSBA 2)	5	127	2½	64	0.375 **0.325** 0.300	9.53 **8.26** 7.62	10.4 **9.3** 8.8	15.48 **13.84** 13.10
B 143	5	127	2½	64	0.240	6.10	8.3	12.35
B 144	4½	114	2¼	57	0.220	5.59	6.7	9.97
B 145	3	76	2	51	0.190	4.83	3.60	5.36
B 146	3	76	1¾	44	0.160	4.06	3.25	4.84
B 147	2½	64	1½	38	0.150	3.81	2.66	3.96

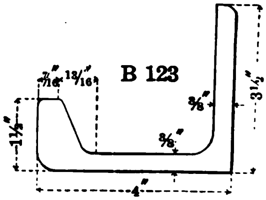
Dimensions and Weights of British Standard Sections are indicated in **bold type**, see notes on page 563.

CAR BUILDING BULB ANGLES



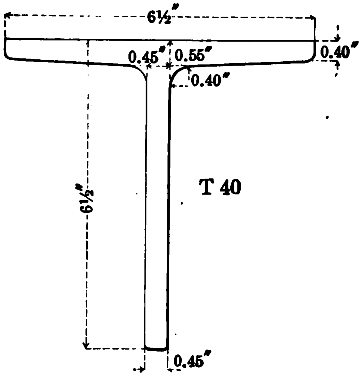


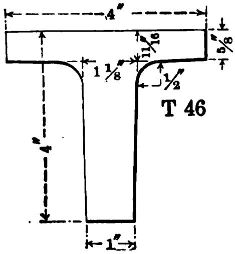


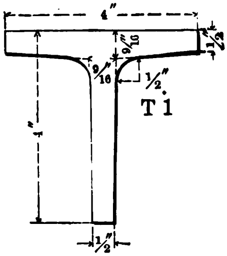


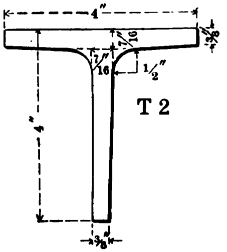
Section Index	Depth		Flange Width		Web Thickness		Weight	
	Inches	m/m	Inches	m/m	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
B 125	5	127	4½	114	.438	11.13	19.3	28.82
B 124	5	127	3½	89	.375	9.53	13.2	19.64
B 122	4	102	3½	89	.500	12.70	1.43	21.28
B 123	4	102	3½	89	.375	9.53	11.9	17.71

TEES WITH EQUAL LEGS—STRUCTURAL SIZES









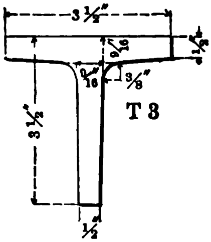
Section Index	Size				Thickness of Metal			Weight	
	Inches		m/m		Inches		m/m	Per Foot, Lbs.	Per Meter, Kilos
	Flange	Stem	Flange	Stem	Flange	Stem	Flange and Stem		
†T 40	6½	6½	165	165	0.40	0.45	10.16 to 11.43	19.8	29.47
T 46	4	4	102	102	5/8 to 11/16	1 to 1 1/8	*	21.1	32.89
T 1	4	4	102	102	1/2 to 9/16	1/2 to 9/16	12.70 to 14.29	13.5	20.09
T 2	4	4	102	102	3/8 to 7/16	3/8 to 7/16	9.53 to 11.11	10.5	15.63

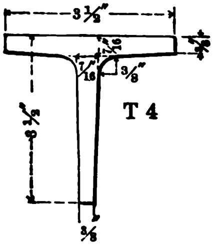
† This section is used in shipbuilding for bracket connections especially in the oil-tight work of tank steamers generally.

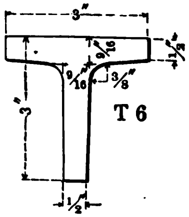
It is used also for connections to the margin plates of the double bottoms of other classes of vessels and its use will be found suitable for bracket connections wherever strength and water-tightness are required.

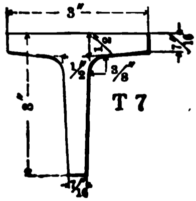
* T 46—Flange 15.88 to 17.46 m/m; Stem 25.40 to 28.5 m/m.

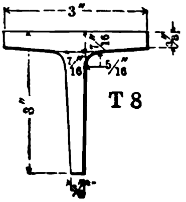
TEES WITH EQUAL LEGS—STRUCTURAL SIZES.—*Continued*

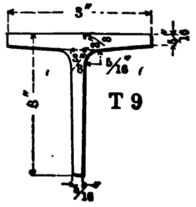








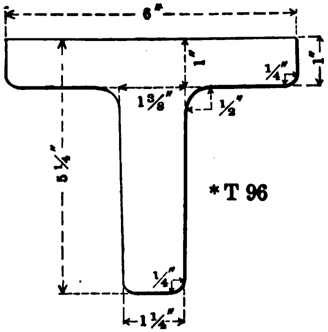




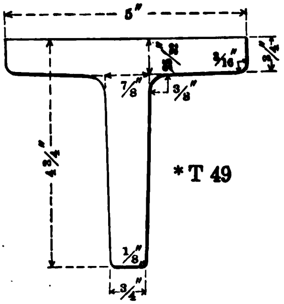
Section Index	Size				Thickness of Metal			Weight	
	Inches		m/m		Inch		m/m		
	Flange	Stem	Flange	Stem	Flange	Stem	Flange and Stem	Per Foot, Pounds	Per Meter, Kilos
T 3	3½	3½	89	89	½ to 9/16	½ to 9/16	12.70 to 14.29	11.7	17.41
T 4	3½	3½	89	89	3/8 to 7/16	3/8 to 7/16	9.53 to 11.11	9.2	13.69
T 6	3	3	76	76	½ to 9/16	½ to 9/16	12.70 to 14.29	9.9	14.73
T 7	3	3	76	76	7/16 to ½	7/16 to ½	11.11 to 12.70	8.9	13.24
T 8	3	3	76	76	3/8 to 7/16	3/8 to 7/16	9.53 to 11.11	7.8	11.61
T 9	3	3	76	76	5/16 to 3/8	5/16 to 3/8	7.94 to 9.53	6.7	9.97

For smaller sizes of Tees with Equal Legs, see pages 160 to 163.

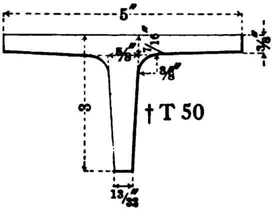
TEES WITH UNEQUAL LEGS—STRUCTURAL SIZES



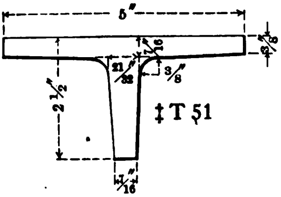
*T 96



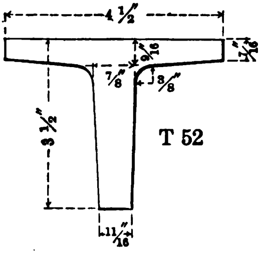
*T 49



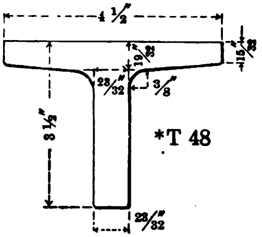
† T 50



‡ T 51



T 52



*T 48

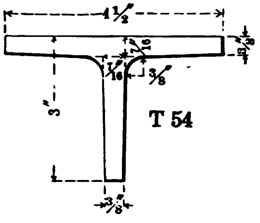
Section Index	Size				Thickness of Metal				Weight	
	Inches		m/m		Flange		Stem		Per Foot, Pounds	Per Meter, Kilos
	Flange	Stem	Flange	Stem	Inch	m/m	Inches	m/m		
*T 96	6	5¼	152	133	1 to 1	25.40 to 25.40	1¼ to 1⅜	31.75 to 34.93	39.4	58.63
*T 49	5	4¾	127	121	¾ to 25/32	19.05 to 19.84	¾ to ⅞	19.05 to 22.23	24.1	35.87
†T 50	5	3	127	76	⅜ to 7/16	9.53 to 11.11	13/32 to ⅝	10.32 to 15.88	11.5	17.11
‡T 51	5	2½	127	64	⅜ to 7/16	9.53 to 11.11	7/16 to 21/32	11.11 to 16.67	10.9	16.22
T 52	4½	3½	114	89	7/16 to 9/16	11.11 to 14.29	11/16 to ⅞	17.46 to 22.23	15.7	23.36
*T 48	4½	3½	114	89	15/32 to 19/32	11.91 to 15.08	23/32 to 23/32	18.26 to 18.26	15.0	22.32

* Furnished only by special arrangement.

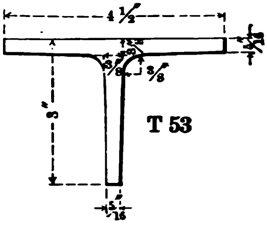
† T 50 can be rolled with flange ½" to 9/16" (12.70 to 14.29 m/m), and stem 3⅛" (79 m/m); weight 13.6 pounds per foot (20.24 kilos per meter).

‡ T 51 can be rolled with flange ½" to 9/16" (12.70 to 14.29 m/m), and stem 2⅝" (67 m/m); weight 13.0 pounds per foot.

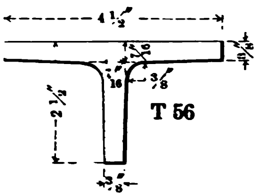
TEES WITH UNEQUAL LEGS—STRUCTURAL SIZES.—*Continued*



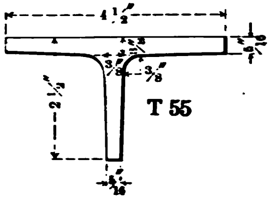
T 54



T 53



T 56



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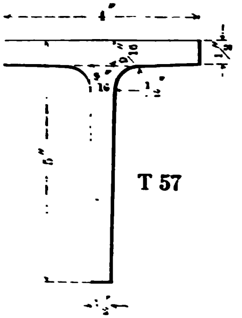

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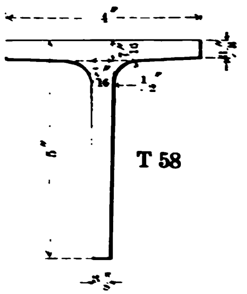
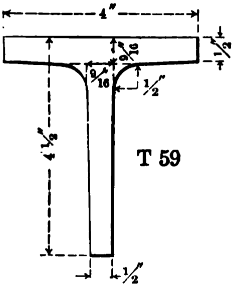
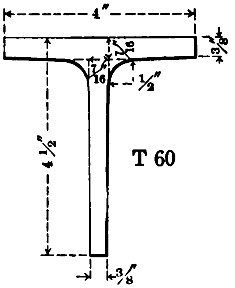


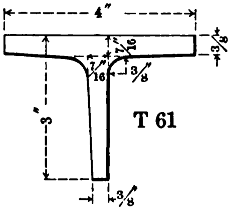
T 58

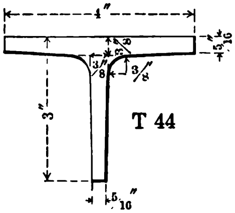
Section Index	Size				Thickness of Metal			Weight	
	Inches		m m		inch		m m	Per Foot. Pounds	Per Meter Kilos
	Flange	Stem	Flange	Stem	Flange	Stem	Flange and Stem		
T 54	4½	3	114	76	3/8 to 7/16	3/8 to 7/16	9.53 to 11.11	9.8	14.58
T 53	4½	3	114	76	5/16 to 3/8	5/16 to 3/8	7.94 to 9.53	8.4	12.50
T 56	4½	2½	114	64	3/8 to 7/16	3/8 to 7/16	9.53 to 11.11	9.2	13.69
T 55	4½	2½	114	64	5/16 to 3/8	5/16 to 3/8	7.94 to 9.53	7.8	11.61
T 57	4	5	102	127	1/2 to 9/16	1/2 to 9/16	12.70 to 14.29	15.3	22.77
T 58	4	5	102	127	3/8 to 7/16	3/8 to 7/16	9.53 to 11.11	11.9	17.71

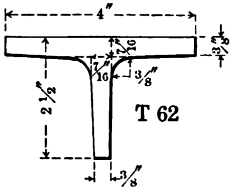
TEES WITH UNEQUAL LEGS—STRUCTURAL SIZES.—*Continued*

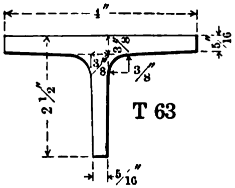


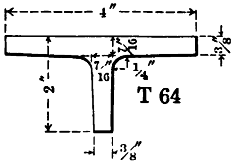


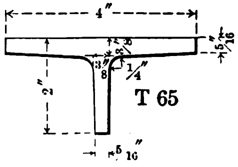






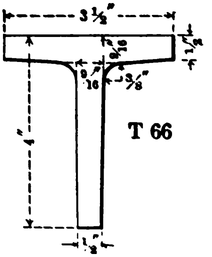


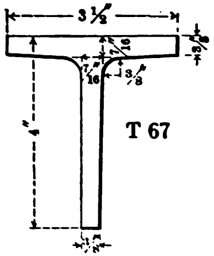


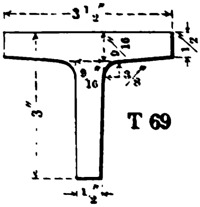


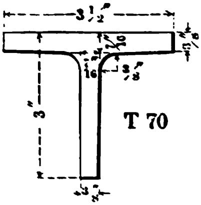
Section Index	Size				Thickness of Metal			Weight	
	Inches		m/m		Inch		m/m	Per Foot, Pounds	Per Meter, Kilos
	Flange	Stem	Flange	Stem	Flange	Stem	Flange and Stem		
T 59	4	4½	102	114	½ to 9/16	½ to 9/16	12.70 to 14.29	14.4	21.43
T 60	4	4½	102	114	⅜ to 7/16	⅜ to 7/16	9.53 to 11.11	11.2	16.67
T 61	4	3	102	76	⅜ to 7/16	⅜ to 7/16	9.53 to 11.11	9.2	13.69
T 44	4	3	102	76	5/16 to ⅜	5/16 to ⅜	7.94 to 9.53	7.8	11.61
T 62	4	2½	102	64	⅜ to 7/16	⅜ to 7/16	9.53 to 11.11	8.5	12.65
T 63	4	2½	102	64	5/16 to ⅜	5/16 to ⅜	7.94 to 9.53	7.2	10.72
T 64	4	2	102	51	⅜ to 7/16	⅜ to 7/16	9.53 to 11.11	7.8	11.61
T 65	4	2	102	51	5/16 to ⅜	5/16 to ⅜	7.94 to 9.53	6.7	9.97

Tees with Unequal Legs—Structural Sizes.—*Continued*


T 66


T 67


T 69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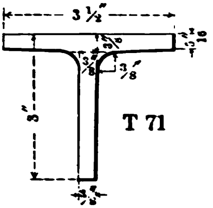
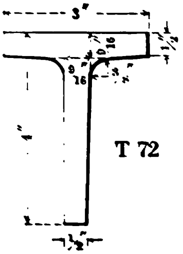

T 71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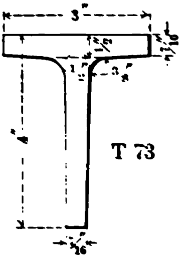
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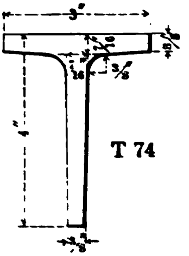
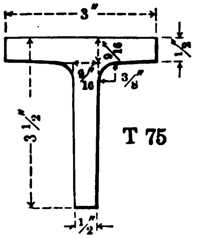
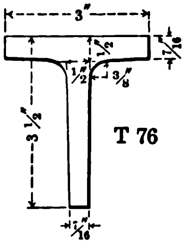

T 74

Section Index	Size				Thickness of Metal				Weight	
	Inches		m m		Flange		Stem		Per Foot. Lbs.	Per Meter. Kilos
	Flange	Stem	Flange	Stem	Inch	m m	Inch	m m		
T 66	3½	4	89	102	½ to 9/16	12.70 to 14.29	½ to 9/16	12.70 to 14.29	12.6	18.75
T 67	3½	4	89	102	⅜ to 7/16	9.53 to 11.11	⅜ to 7/16	9.53 to 11.11	9.8	14.58
T 69	3½	3	89	76	½ to 9/16	12.70 to 14.29	½ to 9/16	12.70 to 14.29	10.8	16.07
T 70	3½	3	89	76	⅜ to 7/16	9.53 to 11.11	⅜ to 7/16	9.53 to 11.11	8.5	12.65
T 71	3½	3	89	76	5/16 to ⅜	7.94 to 9.53	⅜	9.53	7.5	11.16
T 72	3	4	76	102	½ to 9/16	12.70 to 14.29	½ to 9/16	12.70 to 14.29	11.7	17.41
T 73	3	4	76	102	7/16 to ½	11.11 to 12.70	7/16 to ½	11.11 to 12.70	10.5	15.63
T 74	3	4	76	102	⅜ to 7/16	9.53 to 11.11	⅜ to 7/16	9.53 to 11.11	9.2	13.69

TEES WITH UNEQUAL LEGS—STRUCTURAL SIZES.—*Continued*



T 75



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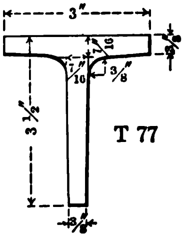
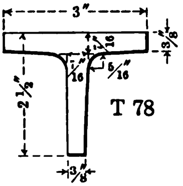


T 77



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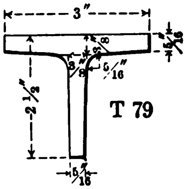
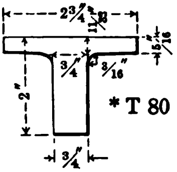
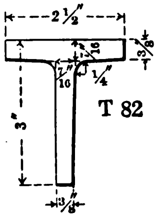


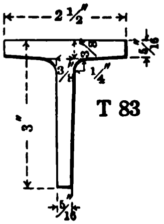
T 79



*T 80



T 82

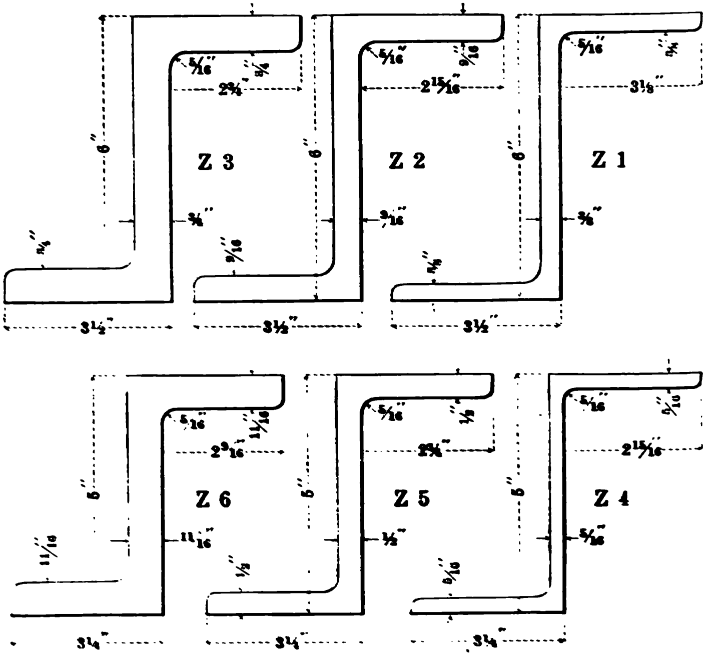


T 83

Section Index	Size				Thickness of Metal				Weight	
	Inches		m/m		Flange		Stem		Per Foot, Lbs.	Per Meter, Kilos
	Flange	Stem	Flange	Stem	Inch	m/m	Inch	m/m		
T 75	3	3½	76	89	½ to 9/16	12.70 to 14.29	½ to 9/16	12.70 to 14.29	10.8	16.07
T 76	3	3½	76	89	7/16 to ½	11.11 to 12.70	7/16 to ½	11.11 to 12.70	9.7	14.44
T 77	3	3½	76	89	3/8 to 7/16	9.53 to 11.11	3/8 to 7/16	9.53 to 11.11	8.5	12.65
T 78	3	2½	76	64	3/8 to 7/16	9.53 to 11.11	3/8 to 7/16	9.53 to 11.11	7.1	10.57
T 79	3	2½	76	64	5/16 to 3/8	7.94 to 9.53	5/16 to 3/8	7.94 to 9.53	6.1	9.08
‡*T 80	2¾	2	70	51	5/16 to 11/32	7.94 to 8.73	23/32 to 23/32	18.26 to 18.26	7.2	10.72
T 82	2½	3	64	76	3/8 to 7/16	9.53 to 11.11	3/8 to 7/16	9.53 to 11.11	7.1	10.57
T 83	2½	3	64	76	5/16 to 3/8	7.94 to 9.53	5/16 to 3/8	7.94 to 9.53	6.1	9.08

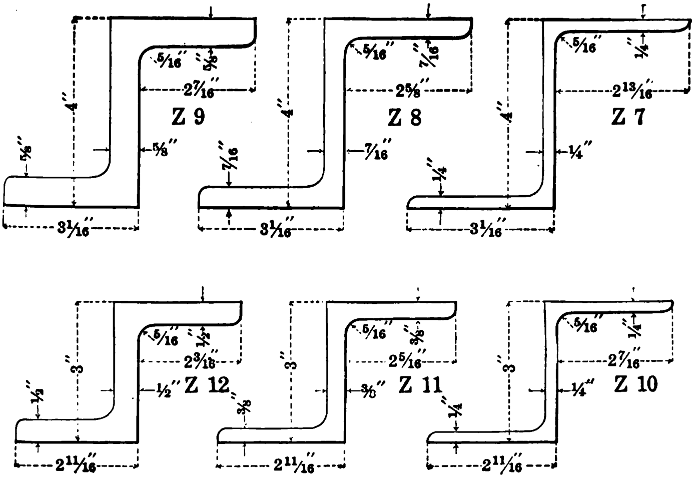
* Furnished only by special arrangement.
‡ Bar mill size, sold at base price for Bars plus bar extras.
For smaller sizes of Tees with Unequal Legs, see pages 164 and 165.

Z-BARS—STRUCTURAL SIZES



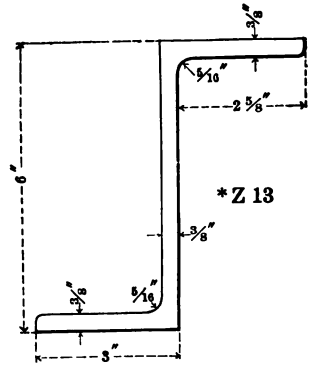
Section Index	Size		Thickness of Metal		Weight	
	Inches Flange Web Flange	Millimeters (Approximate)	Inch	m m	Per Foot, Lbs.	Per Meter, Kilos
Z 3	3 5/8 x 6 1/8 x 3 5/8	92x156x92	7/8	22.23	34.6	51.49
	3 9/16 x 6 1/16 x 3 9/16	90x154x90	13/16	20.64	32.0	47.62
	3 1/2 x 6 x 3 1/2	89x152x89	3/4	19.05	29.4	43.75
Z 2	3 5/8 x 6 1/8 x 3 5/8	92x156x92	11/16	17.46	28.1	41.82
	3 9/16 x 6 1/16 x 3 9/16	90x154x90	5/8	15.88	25.4	37.80
	3 1/2 x 6 x 3 1/2	89x152x89	9/16	14.29	22.8	33.93
Z 1	3 5/8 x 6 1/8 x 3 5/8	92x156x92	1/2	12.70	21.1	31.40
	3 9/16 x 6 1/16 x 3 9/16	90x154x90	7/16	11.11	18.4	27.38
	3 1/2 x 6 x 3 1/2	89x152x89	3/8	9.53	15.7	23.36
Z 6	3 3/8 x 5 1/8 x 3 3/8	86x130x86	13/16	20.64	28.4	42.26
	3 5/16 x 5 1/16 x 3 5/16	84x129x84	3/4	19.05	26.0	38.69
	3 1/4 x 5 x 3 1/4	83x127x83	11/16	17.46	23.7	35.27
Z 5	3 3/8 x 5 1/8 x 3 3/8	86x130x86	5/8	15.88	22.6	33.63
	3 5/16 x 5 1/16 x 3 5/16	84x129x84	9/16	14.29	20.2	30.06
	3 1/4 x 5 x 3 1/4	83x127x83	1/2	12.70	17.9	26.64
Z 4	3 3/8 x 5 1/8 x 3 3/8	86x130x86	7/16	11.11	16.4	24.41
	3 5/16 x 5 1/16 x 3 5/16	84x129x84	3/8	9.53	14.0	20.83
	3 1/4 x 5 x 3 1/4	83x127x83	5/16	7.94	11.6	17.26

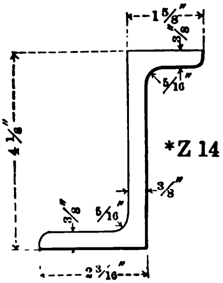
Z-BARS—STRUCTURAL SIZES.—*Continued*

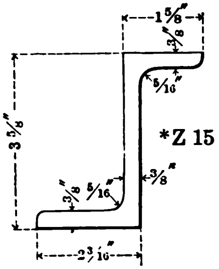


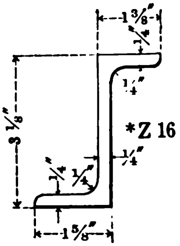
Section Index	Size		Thickness of Metal		Weight	
	Inches Flange Web Flange	Millimeters (Approximate)	Inch	m/m	Per Foot, Pounds	Per Meter, Kilos
Z 9	3 3/16 x 4 1/8 x 3 3/16	81x105x81	3/4	19.05	23.0	34.23
	3 1/8 x 4 1/16 x 3 1/8	79x103x79	11/16	17.46	20.9	31.10
	3 1/16 x 4 x 3 1/16	78x102x78	5/8	15.88	18.9	28.13
Z 8	3 3/16 x 4 1/8 x 3 3/16	81x105x81	9/16	14.29	18.0	26.79
	3 1/8 x 4 1/16 x 3 1/8	79x103x79	1/2	12.70	15.9	23.66
	3 1/16 x 4 x 3 1/16	78x102x78	7/16	11.11	13.8	20.54
Z 7	3 3/16 x 4 1/8 x 3 3/16	81x105x81	3/8	9.53	12.5	18.60
	3 1/8 x 4 1/16 x 3 1/8	79x103x79	5/16	7.94	10.3	15.33
	3 1/16 x 4 x 3 1/16	78x102x78	1/4	6.35	8.2	12.20
Z 12	2 3/4 x 3 1/16 x 2 3/4	70x78x70	9/16	14.29	14.3	21.28
	2 11/16 x 3 x 2 11/16	68x76x68	1/2	12.70	12.6	18.75
Z 11	2 3/4 x 3 1/16 x 2 3/4	70x78x70	7/16	11.11	11.5	17.11
	2 11/16 x 3 x 2 11/16	68x76x68	3/8	9.53	9.8	14.58
Z 10	2 3/4 x 3 1/16 x 2 3/4	70x78x70	5/16	7.94	8.5	12.65
	2 11/16 x 3 x 2 11/16	68x76x68	1/4	6.35	6.7	9.97

Z-Bars—Structural Sizes.—*Continued*









Section Index	Size		Thickness of Metal		Weight	
	Inches Flange Web Flange	Millimeters (Approximate)	Inch	m m	Per Foot, Pounds	Per Meter, Kilos
*Z 13	3 x 6 x 3	76 x 152 x 76	⅜	9.53	14.5	21.58
*Z 14	1⅝ x 4⅛ x 3 3/16	41 x 105 x 56	⅜	9.53	9.2	13.69
*Z 15	1⅝ x 3⅝ x 2 3/16	41 x 92 x 56	⅜	9.53	8.6	12.80
*Z 16	1⅜ x 3⅛ x 1⅝	35 x 79 x 41	¼	6.35	4.8	7.14

* Furnished only by special arrangement.

For smaller sizes of Z-Bars, see pages 167 and 168.

STEEL PLATES

EXTREME SIZES ROLLED

SHEARED PLATES, 1/4-INCH THICK AND OVER

Thickness, Inches	Weight per Square Foot, Pounds	Rectangular Plates										
		Width, Inches										
		132	126	120	114	108	102	96	90	84	78	72
		Extreme Lengths, Inches										
1/4	10.20	...	...	...	175	250	280	300	330	375	400	430
5/16	12.75	...	...	240	270	320	360	380	420	440	460	480
3/8	15.30	180	240	270	320	365	380	410	450	500	550	600
7/16	17.85	200	270	300	360	370	410	430	460	510	550	600
1/2	20.40	240	270	320	365	400	450	480	510	550	580	610
9/16	22.95	240	270	330	373	420	470	500	530	570	600	620
5/8	25.50	240	300	350	390	450	500	520	540	600	620	620
11/16	28.05	240	300	360	420	450	500	520	540	600	620	620
3/4	30.60	240	300	360	400	450	490	520	540	600	620	620
13/16	33.15	240	300	340	385	440	490	510	530	600	620	620
7/8	35.70	240	300	330	375	440	480	510	530	600	620	620
1	40.80	240	300	300	340	440	460	500	530	580	600	600
1 1/8	45.90	240	300	300	330	410	440	450	500	550	580	580
1 1/4	51.00	230	270	300	310	380	400	420	490	530	550	550
1 1/2	61.20	210	230	260	280	330	320	340	420	440	480	530
1 3/4	71.40	200	200	220	240	280	270	300	380	380	410	450
2	81.60	180	180	190	210	240	240	260	320	330	360	400
2 1/4	91.80	132	160	170	190	210	210	230	280	295	320	350

Thickness, Inches	Weight per Square Foot, Pounds	Rectangular Plates (Continued)									Circular Plates
		Width, Inches									Extreme Diam., Inches
		66	60	54	50	48	42	36	30	24	
		Extreme Lengths, Inches									
1/4	10.20	475	525	530	530	530	530	530	530	530	115
5/16	12.75	500	560	550	575	575	550	550	550	580	120
3/8	15.30	600	620	620	620	620	600	580	600	600	132
7/16	17.85	630	630	640	640	640	600	580	600	600	132
1/2	20.40	630	630	640	640	640	600	580	630	600	134
9/16	22.95	640	640	640	640	640	600	580	630	600	134
5/8	25.50	640	640	640	640	640	600	580	600	600	134
11/16	28.05	640	640	640	640	640	600	580	600	580	134
3/4	30.60	640	640	640	640	640	600	580	600	580	134
13/16	33.15	640	640	640	640	640	600	580	570	550	134
7/8	35.70	640	640	640	640	640	600	580	550	550	134
1	40.80	630	630	640	640	640	580	580	520	530	134
1 1/8	45.90	620	620	640	640	640	580	580	520	500	132
1 1/4	51.00	600	600	600	600	600	560	560	520	450	132
1 1/2	61.20	600	600	600	600	600	540	540	470	430	132
1 3/4	71.40	490	550	550	550	550	540	540	430	380	132
2	81.60	440	480	500	500	500	500	500	400	350	132
2 1/4	91.80	390	420	450	450	450	450	450	300	200	132

Plates of greater dimensions than those above may be submitted for special consideration.

Plates 48″ wide and under can also be rolled on Universal Mills. For greater lengths and Universal Mill sizes, see Universal Mill plate table on page 529.

(For metric equivalents of the dimensions in above tables, see page 626.)

STEEL PLATES—EXTREME SIZES ROLLED.—*Continued*

SHEARED PLATES, ¼-INCH THICK AND OVER.—*Continued*

(Metric equivalents of dimensions in table on page 625.

Thickness		Weight per Square Meter, Kilos	Rectangular Plates										
			Width, Meters										
Inches	m/m		3.35	3.20	3.05	2.90	2.74	2.59	2.44	2.29	2.13	1.98	1.83
			Extreme Lengths, Meters										
¼	6.35	49.801	....	....	....	4.44	6.35	7.11	7.62	8.38	9.53	10.16	10.92
5/16	7.94	62.251	....	....	6.10	6.86	8.13	9.14	9.65	10.67	11.18	11.68	12.19
⅜	9.53	74.701	4.57	6.10	6.86	8.13	9.27	9.65	10.41	11.43	12.70	13.97	15.24
7/16	11.11	87.151	5.08	6.86	7.62	9.14	9.40	10.41	10.92	11.68	12.95	13.97	15.24
½	12.70	99.601	6.10	6.86	8.13	9.27	10.16	11.43	12.19	12.95	13.97	14.73	15.49
9/16	14.29	112.051	6.10	6.86	8.38	9.47	10.67	11.94	12.70	13.46	14.48	15.24	15.75
⅝	15.88	124.501	6.10	7.62	8.89	9.90	11.43	12.70	13.21	13.72	15.24	15.75	15.75
11/16	17.46	136.952	6.10	7.62	9.14	10.67	11.43	12.70	13.21	13.72	15.24	15.75	15.75
¾	19.05	149.402	6.10	7.62	9.14	10.16	11.43	12.45	13.21	13.72	15.24	15.75	15.75
13/16	20.64	161.852	6.10	7.62	8.64	9.78	11.18	12.45	12.95	13.46	15.24	15.75	15.75
⅞	22.23	174.302	6.10	7.62	8.38	9.53	11.18	12.19	12.95	13.46	15.24	15.75	15.75
1	25.40	199.202	6.10	7.62	7.62	8.64	11.18	11.68	12.70	13.46	14.73	15.24	15.24
1⅛	28.58	224.103	6.10	7.62	7.62	8.38	10.41	11.18	11.43	12.70	13.97	14.73	14.73
1¼	31.75	249.003	5.84	6.86	7.62	7.87	9.65	10.16	10.67	12.45	13.46	13.97	13.97
1½	38.10	298.803	5.33	5.84	6.60	7.11	8.38	8.13	8.64	10.67	11.18	12.19	13.46
1¾	44.45	348.604	5.08	5.08	5.59	6.10	7.11	6.86	7.62	9.65	9.65	10.41	11.43
2	50.80	398.405	4.57	4.57	4.83	5.33	6.10	6.10	6.60	8.13	8.38	9.14	10.16
2¼	57.15	448.205	3.35	4.06	4.32	4.83	5.33	5.33	5.84	7.11	7.49	8.13	8.89

Thickness		Weight per Square Meter, Kilos	Rectangular Plates (Continued)									Circular Plates
			Width, Meters									Extreme Diam., Meters
Inches	m/m		1.68	1.52	1.37	1.27	1.22	1.07	0.91	0.76	0.61	
			Extreme Lengths, Meters									
¼	6.35	48.801	12.06	13.33	13.46	13.46	13.46	13.46	13.46	13.46	13.46	2.92
5/16	7.94	62.251	12.70	14.22	13.97	14.61	14.61	13.97	13.97	13.97	14.73	3.05
⅜	9.53	74.701	15.24	15.75	15.75	15.75	15.75	15.24	14.73	15.24	15.24	3.35
7/16	11.11	87.151	16.00	16.00	16.26	16.26	16.26	15.24	14.73	15.24	15.24	3.35
½	12.70	99.601	16.00	16.00	16.26	16.26	16.26	15.24	14.73	16.00	15.24	3.40
9/16	14.29	112.051	16.26	16.26	16.26	16.26	16.26	15.24	14.73	16.00	15.24	3.40
⅝	15.88	124.501	16.26	16.26	16.26	16.26	16.26	15.24	14.73	15.24	15.24	3.40
11/16	17.46	136.952	16.26	16.26	16.26	16.26	16.26	15.24	14.73	15.24	14.73	3.40
¾	19.05	149.402	16.26	16.26	16.26	16.26	16.26	15.24	14.73	15.24	14.73	3.40
13/16	20.64	161.852	16.26	16.26	16.26	16.26	16.26	15.24	14.73	14.48	13.97	3.40
⅞	22.23	174.302	16.26	16.26	16.26	16.26	16.26	15.24	14.73	13.97	13.97	3.40
1	25.40	199.202	16.00	16.00	16.26	16.26	16.26	14.73	14.73	13.21	13.46	3.40
1⅛	28.58	224.103	15.75	15.75	16.26	16.26	16.26	14.73	14.73	13.21	12.70	3.35
1¼	31.75	249.003	15.24	15.24	15.24	15.24	15.24	14.22	14.22	13.21	11.43	3.35
1½	38.10	298.803	15.24	15.24	15.24	15.24	15.24	13.72	13.72	11.94	10.92	3.35
1¾	44.45	348.604	12.45	13.97	13.97	13.97	13.97	13.72	13.72	10.92	9.65	3.35
2	50.80	398.405	11.18	12.19	12.70	12.70	12.70	12.70	12.70	10.16	8.89	3.35
2¼	57.15	448.205	9.90	10.67	11.43	11.43	11.43	11.43	11.43	7.62	5.08	3.35

Plates of greater dimensions than those above may be submitted for special consideration.

Plates 1.22 meters wide and under can also be rolled on Universal Mills. For greater lengths and Universal Mill sizes, see Universal Mill plate table on page 629.

(*For dimensions in inches see table on page 625.*)

STEEL PLATES—EXTREME SIZES ROLLED.—*Continued*

SHEARED PLATES, $\frac{3}{16}$-INCH THICK AND UNDER

kness	Weight per Square Foot, Pounds	Rectangular Plates						
		Width, Inches						
		74	72	70	68	66	64	60
		Extreme Lengths, Inches						
	7.65	200	220	240	250	270	320	375
3. W. G.	6.73	...	200	210	216	230	260	280
3. W. G.	6.04	...	...	160	170	190	220	240
3. W. G.	5.47	...	...	...	144	170	200	230
	5.10	...	...	...	...	140	150	160
3. W. G.	....	...	...	...	...	140	150	160
3. W. G.	....	...	...	...	...	120	130	144

:ness	Weight per Square Foot, Pounds	Rectangular Plates (Continued)						Circular Plates
		Width, Inches						Extreme Diam., Inches
		54	48	42	36	30	24	
		Extreme Lengths, Inches						
	7.65	400	400	400	375	375	400	77
3. W. G.	6.73	300	340	350	350	350	340	74
3. W. G.	6.04	280	300	310	330	330	280	70
3. W. G.	5.47	240	260	270	300	300	260	68
	5.10	200	220	230	260	260	260	66
3. W. G.	....	200	220	230	260	260	260	66
3. W. G.	....	180	200	220	240	240	240	64

gular Plates $\frac{3}{16}$″ thick, over 74″ wide and Circular Plates $\frac{3}{16}$″ thick,
diameter can be furnished to gauge only and only under certain condi-
uch sizes should be submitted for special consideration.
under $\frac{3}{16}$″ thick are furnished only by special arrangement. Plates
an $\frac{1}{8}$″ should be specified to gauge only.
of greater dimensions than shown in above table, may be submitted
l consideration.
etric equivalents of the dimensions in above tables, see page 628.)

STEEL PLATES—EXTREME SIZES ROLLED.—*Continued*

SHEARED PLATES, $\frac{3}{16}$-INCH THICK AND UNDER

(Metric equivalents of dimensions in table on page 627)

Thickness		Weight per Square Meter, Kilos	Rectangular Plates						
			Width, Centimeters						
	m. m		188	183	178	173	168	163	152
			Extreme Lengths, Meters						
$\frac{3}{16}$"	4.76	37.350	5.08	5.59	6.10	6.35	6.86	8.13	9.53
* No. 8 B. W. G.	4.19	32.868	...	5.08	5.33	5.49	5.84	6.60	7.11
* No. 9 B. W. G.	3.76	29.482	...	....	4.06	4.32	4.83	5.59	6.10
* No. 10 B. W. G.	3.40	26.693	...	....	....	3.66	4.32	5.08	5.84
* $\frac{1}{8}$"	3.18	24.900	...	....	....	....	3.56	3.81	4.06
* No. 11 B. W. G.	3.05	......	...	....	....	....	3.56	3.81	4.06
* No. 12 B. W. G.	2.77	......	...	....	....	....	3.05	3.30	3.66

Thickness		Weight per Square Meter, Kilos	Rectangular Plates (*Continued*)						Circular Plates
			Width, Centimeters						
	m m		137	122	107	91	76	61	Extreme Diam., Meters
			Extreme Lengths, Meters						
$\frac{3}{16}$"	4.76	37.350	10.16	10.16	10.16	9.53	9.53	10.16	1.96
* No. 8 B. W. G.	4.19	32.868	7.62	8.64	8.89	8.89	8.89	8.64	1.88
* No. 9 B. W. G.	3.76	29.482	7.11	7.62	7.87	8.38	8.38	7.11	1.78
* No. 10 B. W. G.	3.40	26.693	6.10	6.60	6.86	7.62	7.62	6.60	1.73
* $\frac{1}{8}$"	3.18	24.900	5.08	5.59	5.84	6.60	6.60	6.60	1.68
* No. 11 B. W. G.	3.05	......	5.08	5.59	5.84	6.60	6.60	6.60	1.68
* No. 12 B. W. G.	2.77	......	4.57	5.08	5.59	6.10	6.10	6.10	1.63

Rectangular Plates $\frac{3}{16}$" (4.76 m. m) thick, over 74" ($1^{m}88$) wide, and Circular Plates $\frac{3}{16}$" (4.76 m m) thick, over 77" ($1^{m}96$) diameter, can be furnished to gauge only and only under certain conditions. Such sizes should be submitted for special consideration.

*Plates under $\frac{3}{16}$" (4.76 m m) thick are furnished only by special arrangement. Plates lighter than $\frac{1}{8}$" (3.18 m m) should be specified to gauge only.

Plates of greater dimensions than shown in above table, may be submitted for special consideration.

STEEL PLATES—EXTREME SIZES ROLLED.—*Continued*

RECTANGULAR UNIVERSAL MILL PLATES

¼-INCH THICK AND OVER

Thickness, Inches	Weight per Square Foot, Pounds	Width, Inches										
		48-46	45-41	40-36	35-31	30-26	25-20	19-17	16-15	14-12	11	10-6⅛
		Extreme Lengths, Inches										
¼	10.2	....	....	....	....	....	1020	1020	1020	1020	540	540
5/16	12.75	1020	1020	1140	1260	1320	1320	1080	1080	1080	600	600
⅜	15.3	1200	1200	1320	1380	1380	1380	1080	1080	1080	900	840
7/16	17.85	1320	1320	1380	1380	1380	1380	1080	1080	1080	900	840
½	20.4	1380	1380	1380	1380	1380	1380	1080	1080	1080	1020	840
9/16	22.95	1380	1380	1380	1380	1380	1380	1080	1080	1080	1020	840
⅝	25.5	1380	1380	1380	1380	1380	1380	1080	1080	1080	1020	840
¾	30.6	1353	1357	1363	1372	1380	1380	1080	1080	1080	900	840
⅞	35.7	1160	1163	1169	1177	1188	1203	1080	1080	1080	900	840
1	40.8	1015	1018	1023	1030	1039	1052	1080	1080	1080	900	840
1⅛	45.9	903	905	910	916	924	936	1080	1080	1080	840	840
1¼	51.	812	814	818	824	832	842	1071	1080	1080	840	840
1⅜	56.1	738	740	744	749	756	766	973	1080	1080	840	840
1½	61.2	677	679	682	687	693	702	892	1059	1080	840	840
1⅝	66.3	625	626	629	634	640	648	823	978	1080	840	840
1¾	71.4	580	581	584	588	594	601	765	908	1038	720	720
1⅞	76.5	541	543	545	549	554	561	714	847	968	660	720
2	81.6	507	509	511	515	519	526	669	794	907	600	720

METRIC EQUIVALENTS OF ABOVE DIMENSIONS

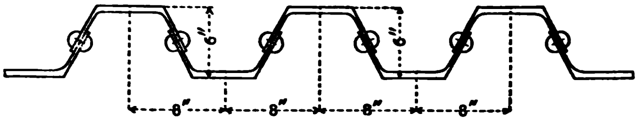
Thickness		Weight per Square Meter, Kilos	Width, Centimeters										
Ins.	m/m		122-117	114-104	102-91	89-79	76-66	64-51	48-43	41-38	36-30	28	25-16
			Extreme Lengths, Meters										
¼	6.35	49.801	.....	.....	.....	.....	.....	25.91	25.91	25.91	25.91	13.72	13.72
5/16	7.94	62.251	25.91	25.91	28.96	32.00	33.53	33.53	27.43	27.43	27.43	15.24	15.24
⅜	9.53	74.701	30.48	30.48	33.53	35.05	35.05	35.05	27.43	27.43	27.43	22.86	21.34
7/16	11.11	87.151	33.53	33.53	35.05	35.05	35.05	35.05	27.43	27.43	27.43	22.86	21.34
½	12.70	99.601	35.05	35.05	35.05	35.05	35.05	35.05	27.43	27.43	27.43	25.91	21.34
9/16	14.29	112.051	35.05	35.05	35.05	35.05	35.05	35.05	27.43	27.43	27.43	25.91	21.34
⅝	15.88	124.501	35.05	35.05	35.05	35.05	35.05	35.05	27.43	27.43	27.43	25.91	21.34
¾	19.05	149.402	34.37	34.47	34.62	34.85	35.05	35.05	27.43	27.43	27.43	22.86	21.34
⅞	22.23	174.302	29.46	29.54	29.69	29.90	30.18	30.56	27.43	27.43	27.43	22.86	21.34
1	25.40	199.202	25.78	25.86	25.98	26.16	26.39	26.72	27.43	27.43	27.43	22.86	21.34
1⅛	28.58	224.103	22.94	22.99	23.11	23.27	23.47	23.77	27.43	27.43	27.43	21.34	21.34
1¼	31.75	249.003	20.62	20.68	20.78	20.93	21.13	21.39	27.20	27.43	27.43	21.34	21.34
1⅜	34.93	273.903	18.75	18.80	18.90	19.02	19.20	19.46	24.71	27.43	27.43	21.34	21.34
1½	38.10	298.803	17.20	17.25	17.32	17.45	17.60	17.83	22.66	26.90	27.43	21.34	21.34
1⅝	41.28	323.704	15.88	15.90	15.98	16.10	16.26	16.46	20.90	24.84	27.43	21.34	21.34
1¾	44.45	348.604	14.73	14.76	14.83	14.94	15.09	15.27	19.43	23.06	26.36	18.29	18.29
1⅞	47.63	373.504	13.74	13.79	13.84	13.94	14.07	14.25	18.14	21.51	24.59	16.76	18.29
2	50.80	398.405	12.88	12.93	12.98	13.08	13.18	13.36	16.99	20.17	23.04	15.24	18.29

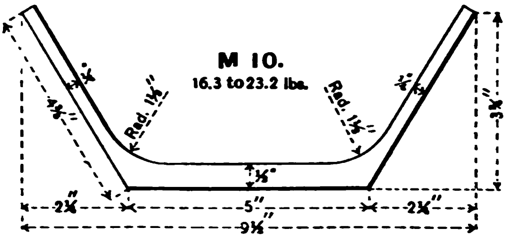
Plates of greater dimensions than shown in the above tables may be submitted for special consideration.

Both Sheared and Universal Mill Plates of extreme dimensions, as shown in the foregoing tables, are subject to special prices.

TROUGH-PLATE FLOORING

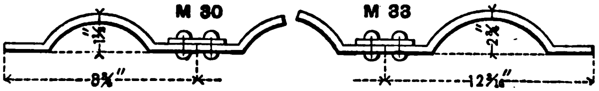
For Floors of Bridges and Fireproof Buildings



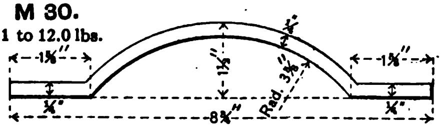


Description	M 10	M 11	M 12	M 13	M 14
Width of plate, inches	$9\frac{1}{2}$	$9\frac{1}{2}$	$9\frac{1}{2}$	$9\frac{1}{2}$	$9\frac{1}{2}$
" " " millimeters	241	241	241	241	241
Depth of plate, inches	$3\frac{3}{4}$	$3\frac{3}{4}$	$3\frac{3}{4}$	$3\frac{3}{4}$	$3\frac{3}{4}$
" " " millimeters	95	95	95	95	95
Thickness of metal, inches	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$
" " " millimeters	12.70	14.29	15.88	17.46	19.05
Weight per lineal foot of rolled section, pounds	16.30	18.00	19.70	21.40	23.20
Weight per lineal meter of rolled section, kilos	24.26	26.79	29.32	31.85	34.53
Weight per square foot of floor surface, pounds	24.5	27.0	29.6	32.1	34.8
Weight per square meter of floor surface, kilos	119.62	131.82	144.52	156.73	169.91

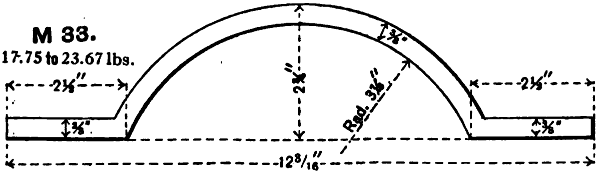
CORRUGATED PLATE FLOORING



M 30.
8.1 to 12.0 lbs.



M 33.
17.75 to 23.67 lbs.

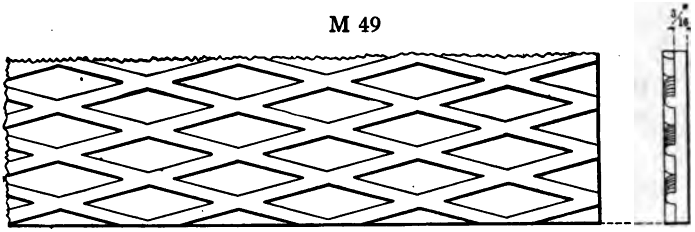


Description	M 30	M 31	M 32	M 33	M 34	M 35
th of plate, inches	8¾	8¾	8¾	12 3/16	12 3/16	12 3/16
" " millimeters	222	222	222	310	310	310
th of corrugation, inches	1½	1 9/16	1⅝	2¾	2 13/16	2⅞
" " millimeters	38	40	41	70	71	73
kness of metal, inches	¼	5/16	⅜	⅜	7/16	½
" " " millimeters	6.35	7.94	9.53	9.53	11.11	12.70
;ht per lineal foot of rolled :tion, pounds	8.1	10.1	12.0	17.8	20.7	23.7
;ht per lineal meter of rolled :tion, kilos	12.05	15.03	17.86	26.49	30.96	35.27
;ht per square foot of floor rface, pounds	11.5	13.8	16.5	17.5	20.4	23.3
;ht per square meter of floor rface, kilos	56.2	67.4	80.6	85.4	99.6	113.8

ights given per square foot and per square meter do not include weight of splice plates.

CHECKERED PLATE

M 49



Section Index	Thickness of Metal		Width, Inches			Width, Centimeters			Weight	
	Inch	m/m	6 to 11⅞	12 to 48	48⅛ to 60	15.24 to 30.16	30.48 to 121.92	122.24 to 152.40	Per Square Foot, Pounds	Per Square Meter, Kilos
			Length, Inches			Length, Meters				
M 54	½	12.70	120	240	240	3.05	6.10	6.10	21.4	104.48
M 53	7/16	11.11	120	240	240	3.05	6.10	6.10	18.9	92.28
M 52	⅜	9.53	120	240	240	3.05	6.10	6.10	16.3	79.59
M 51	5/16	7.94	120	240	240	3.05	6.10	6.10	13.8	67.38
M 50	¼	6.35	120	240	240	3.05	6.10	6.10	11.2	54.68
M 49	3/16	4.76	120	180	...	3.05	4.57	....	8.7	42.48

ALLOWABLE UNIFORM LOAD IN POUNDS PER SQUARE FOOT

Span in Feet	Fiber Stress, 16000 Pounds per Sq. In.						Fiber Stress, 12000 Pounds per Sq. In.					
	M 54	M 53	M 52	M 51	M 50	M 49	M 54	M 53	M 52	M 51	M 50	M 49
1	5333	4083	3000	2083	1333	746	4000	3064	2248	1560	1000	560
2	1333	1021	750	520	333	187	1000	766	562	390	250	140
3	593	454	333	232	148	83	444	340	250	173	111	62
4	333	255	188	130	83	47	250	191	141	97	63	
5	213	163	120	83	53		160	122	90	62		
6	148	113	83	58			111	85	62			
7	109	83	61				82	63				
8	83	64					62					
9	66											

The values given in above table are the safe loads per square foot of plates supported on two sides only and are based upon the resistance of rectangular sections, 12 inches by the net section, t.

The weight of the plates are included in the safe loads and must be deducted to obtain the net superimposed safe load.

Safe loads for other fiber stresses than those given in table may be obtained from the values given by direct proportion of the fiber stresses.

STANDARD EYEBARS

The form and sizes of heads of eyebars given in the following pages ose corresponding to the dies in use at the plants of the American Bridge ıany.

: maximum length of a finished bar is limited by the maximum length reight of a rolled bar as furnished by the mills, which has a maximum ı of 70 feet (21.336 meters), or a maximum weight of 7700 pounds (3493

: minimum lengths (from center to center of pins), which can be readily are:
ı. (127 m/m) bars and less, 5 feet (1.524 meters).
ı. (152.40 m/m) and 7 in. (177.80 m/m) bars, 10 feet (3.048 meters).
ı. (203.20 m/m) bars and over, 13 feet (3.963 meters).

laximum Thickness of Standard Eyebars is 2 inches (50.80 m/m).

Thickness of eyebar heads may overrun the thickness specified by (1.588 m/m) for bars 8 in. (203.20 m/m) wide and under.

· bars over 8 in. (203.20 m/m) but not exceeding 12 in. (304.80 m/m) the thickness of the head may overrun the thickness specified by $\frac{1}{8}$ in. i m/m).

· bars over 12 in. (304.80 m/m) wide the thickness of the head may ın the thickness specified by $\frac{3}{16}$ in. (4.763 m/m).

cial attention is called to the minimum and maximum thicknesses. se limits are not followed good results cannot be guaranteed.

If the purchaser desires tests on eyebars, the required test should be specified with the order, and if full size tests are required he should state ıer the full size tests, or specimen tests, are to determine the acceptance ·s. In no case must the acceptance of the bar depend upon the require- s of both tests being fulfilled.

When the acceptance of the bar depends upon the specimen tests the rs will be manufactured from basic open hearth structural steel of the recommended in the specifications for "Steel Railroad Bridges," adopt- the American Railway Engineering Association, 1910. (See page 511 s catalogue.)

When the acceptance of the bar depends upon the full size tests the ican Bridge Company reserves the right to specify the specimen tests re- 1 from the rolling mills, and the eyebars will be manufactured to meet the ring requirements:

·s shall develop a minimum ultimate strength of 55,000 pounds per e inch (38.665 kilos per square m/m). The fracture shall be silky or fine lar. The elongation in 10 feet (3.048 meters), including fracture, shall t less than 15 per cent. Should a bar break in the head and develop the ied ultimate strength, it shall not be cause for rejection, provided not than one-third the total number of bars tested break in the head.

: maximum length of eyebars which can be tested is 35 feet (10.668 ·s), center to center of pins.

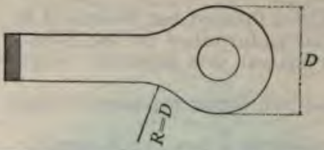
Eyebars specified to be made of any other grade of steel, or requiring tests, or of any other thickness or dimensions than those given above, e special.

ORDINARY EYEBARS

(Manufactured by American Bridge Company)

Bars are hydraulic forged and are guaranteed to develop the full strength of the bar under conditions given in the table when tested to destruction.

Bars marked * should only be used when absolutely unavoidable



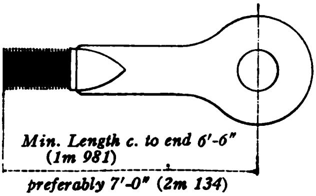
Bar						Head					
Width		Thickness				Diameter		Maximum Pin		Additional Material for One Head	
		Max.		Min.							
Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ft.Ins.	Meters
2	51	1	25	½	12.7	4½ 5½ *6½	114 140 *165	1¾ 2¾ 3¾	44 70 95	1- 0 1- 4 1- 9	0.305 0.406 0.533
2½	64	1	25	⅝	15.9	6 7 *8	152 178 *203	2½ 3½ 4½	64 89 114	1- 3 1- 7 2- 0	0.381 0.483 0.610
3	76	1½	38	⅝	15.9	7½ 8½ *9½	190 216 *241	3¼ 4¼ 5¼	83 108 133	1- 6 1-11 2- 4	0.457 0.584 0.711
4	102	1¾	44	¾ ⅞ 1	19.0 22.2 25.4	10 11 *12	254 279 *305	4½ 5½ 6½	114 140 165	1-11 2- 3 2- 8	0.584 0.686 0.813
5	127	2	51	¾ 1 1	19.0 25.4 25.4	12 13½ *15	305 343 *381	5¼ 6¾ 8¼	133 171 210	2- 1 2- 8 3- 3	0.635 0.813 0.991
6	152	2	51	¾ 1 1	19.0 25.4 25.4	14 14¾ *16½	356 375 *419	5¾ 6½ 8¼	146 165 210	2- 4 2- 6 3- 2	0.711 0.762 0.965
7	178	2	51	1 1⅛ 1⅛	25.4 28.6 28.6	16½ 17½ *18½	419 445 *470	7 8 9	178 203 229	2- 7 2-11 3- 4	0.787 0.889 1.016
8	203	2	51	1 1⅛ 1¼	25.4 28.6 31.8	18 19 *20	457 483 *508	7 8 9	178 203 229	2- 8 3- 0 3- 4	0.813 0.914 1.016
9	229	2	51	1⅛ 1¼	28.6 31.8	20 22	508 559	7½ 9½	191 241	2-11 3- 7	0.889 1.092
10	254	2	51	1⅛ 1¼ 1⅜	28.6 31.8 34.9	22½ 24 *25	572 610 *635	9 10½ 11½	229 267 292	3- 5 3- 9 4- 1	1.041 1.143 1.245
12	305	2	51	1¼ 1⅜ 1½	31.8 34.9 38.1	26½ 28 *29½	673 711 *749	10 11½ 13	254 292 330	3- 8 4- 2 4- 8	1.118 1.270 1.422
14	356	2	51	1⅜ 1½ 1⅝	34.9 38.1 41.3	31 33 *34	787 838 *864	12 14 15	305 356 381	4- 3 4-10 5- 5	1.295 1.473 1.651
--	406	2	51	1¾ 1⅞	44.5 47.6	36 *37½	914 *953	14 16	356 406	4-11 5- 5	1.499 1.651

ADJUSTABLE EYEBARS

(Manufactured by American Bridge Company)

Bars are hydraulic forged and are guaranteed to develop the full strength of the bar under conditions given in the table when tested to destruction.

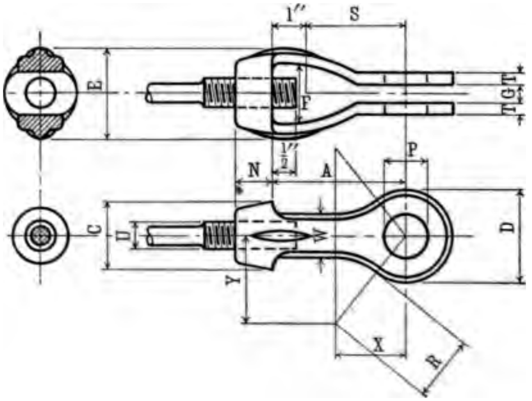
Bars marked * should only be used when absolutely unavoidable



Bar				Screw End					
Width		Minimum Thickness		Diameter		Length (Screwed)		Additional Material For One Screw End	
Ins.	m/m	Ins.	m/m	Ins.	m/m	Ins.	m/m	Ft. Ins.	Meters
2	51	* ⅝	*15.9	1¾	44	4	102	1- 0	0.305
		¾	19.0	1⅞	48	4½	114	1- 0	0.305
		⅞	22.2	2	51	4½	114	0-11	0.279
2½	·64	*¾	*19.0	2⅛	54	4½	114	1- 0	0.305
		⅞	22.2	2¼	57	5	127	1- 0	0.305
		1	25.4	2⅜	60	5	127	1- 0	0.305
3	76	*¾	*19.0	2¼	57	5	127	1- 0	0.305
		⅞	22.2	2½	64	5½	140	1- 1	0.330
		1	25.4	2½	64	5½	140	1- 1	0.330
4	102	*¾	*19.0	2½	64	5½	140	1- 1	0.330
		⅞	22.2	2¾	70	5½	140	0-11	0.279
		1	25.4	3	76	6	152	1- 1	0.330
		1⅛	28.6	3¼	83	6½	165	1- 2	0.356
5	127	*¾	*19.0	2⅞	73	6	152	1- 0	0.305
		⅞	22.2	3	76	6	152	0-11	0.279
		1	25.4	3¼	83	6½	165	1- 0	0.305
		1⅛	28.6	3½	89	7	178	1- 1	0.330
		1¼	31.8	3¾	95	7	178	1- 2	0.356
6	152	*1	*25.4	3½	89	7	178	1- 0	0.305
		1⅛	28.6	3¾	95	7	178	1- 0	0.305
		1¼	31.8	4	102	7½	191	1- 1	0.330
		1⅜	34.9	4¼	108	8	203	1- 2	0.356
7	178	*1⅛	*28.6	4	102	7½	191	1- 0	0.305
		1¼	31.8	4¼	108	8	203	1- 1	0.330
		1⅜	34.9	4½	114	8½	216	1- 2	0.356
		1½	38.1	4¾	121	8½	216	1- 2	0.356
8	203	*1⅛	*28.6	4¼	108	8	203	1- 0	0.305
		1¼	31.8	4½	114	8½	216	1- 1	0.330
		1⅜	34.9	4¾	121	8½	216	1- 1	0.330
		1½	38.1	5	127	9	229	1- 2	0.356
		1⅝	41.3	5¼	133	9½	241	1- 3	0.381

STANDARD CLEVISES

(Manufactured by American Bridge Company)



DIMENSIONS IN INCHES

No.	Head								Nut					Fork			Weight in Pounds
	D	W	T	Max. P	Min. P	R	X	Y	N	C	Max. U	Min. U	E	F	A	S	
3	3	1½	½	1½	1	2¼	2¼	3	1½	2¼	1⅛	1	3 1/16	1¼	5	4	4
4	4	2	½	2	1¼	3	3	4	1¾	2⅞	1⅝	1⅛	3⅝	1¾	6	5	8
5	5	2½	⅝	2½	1½	3¾	3¾	5	2¼	3¾	2⅛	1½	4½	2¼	7	6	16
6	6	3	¾	3	2	4½	4½	6	2½	4⅜	2⅝	2	5⅜	2¾	8	7	26
7	7	3½	⅞	3½	2½	5¼	5¼	7	3	5	3	2¼	6 3/16	3¼	9	8	36

DIMENSIONS IN MILLIMETERS

No.	Head								Nut					Fork			Weight in Kilos
	D	W	T	Max. P	Min. P	R	X	Y	N	C	Max. U	Min. U	E	F	A	S	
3	76	38	12.7	38	25	57	57	76	38	57	29	25	78	32	127	102	1.81
4	102	51	12.7	51	32	76	76	102	44	73	41	29	92	44	152	127	3.63
5	127	64	15.9	64	38	95	95	127	57	95	54	38	114	57	178	152	7.26
6	152	76	19.0	76	51	114	114	152	64	111	67	51	137	70	203	178	11.79
7	178	89	22.2	89	64	133	133	178	76	127	76	57	157	83	229	203	16.33

"Grip "G" can be made to suit connections, and should equal thickness of Gusset Plate + ¼" (6.35 m m) but must not exceed dimension "F".

STANDARD CLEVISES.—*Continued*

TABLE SHOWING CLEVISES TO BE USED WITH GIVEN ROD AND PIN

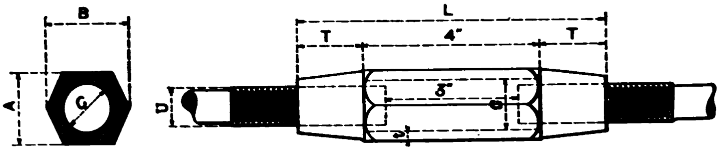
Clevises above and to right of heavy zigzag line may be used with forks straight.

Clevises below and to left of heavy zigzag line should have forks closed in so as not to overstrain pin.

Size of Rod					Diameter of Pin											
d	Square		Upset		Inches	1"	1¼"	1½"	1¾"	2"	2¼"	2½"	2¾"	3"	3¼"	3½"
/m	In.	m/m	In.	m/m	Millimeters	25.40	31.75	38.10	44.45	50.80	57.15	63.50	69.85	76.20	82.55	88.90
9	....	.....	1	25	No. of Clevis	3	3	3	....	....	....	....	....	....	....	....
..	¾	19	1⅛	29	" "	3	3	3	4	4	....	....	....	....	....	....
2	⅞	22	1¼	32	" "	....	4	4	4	4	....	....	....	....	....	....
5	....	.....	1⅜	35	" "	....	4	4	4	4	....	....	....	....	....	....
9	1	25	1½	38	" "	....	4	4	4	4	5	5	....	....	....	....
2	1⅛	29	1⅝	41	" "	....	4	4	4	4	5	5	....	....	....	....
5	....	.....	1¾	44	" "	....	....	5	5	5	5	5	....	....	....	....
	1¼	32	1⅞	48	" "	....	....	5	5	5	5	5	....	....	....	....
	1⅜	35	2	51	" "	....	....	5	5	5	5	5	6	6	....	....
	....	.....	2⅛	54	" "	....	....	5	5	5	5	5	6	6	....	....
	1½	38	2¼	57	" "	....	....	....	....	6	6	6	6	6	7	7
	1⅝	41	2⅜	60	" "	....	....	....	....	6	6	6	6	6	7	7
	1¾	44	2½	64	" "	....	....	....	....	6	6	6	6	6	7	7
	....	.....	2⅝	67	" "	....	....	....	....	6	6	6	6	6	7	7
	1⅞	48	2¾	70	" "	....	....	....	....	....	....	7	7	7	7	7
	2	51	2⅞	73	" "	....	....	....	....	....	....	7	7	7	7	7
	2⅛	54	3	76	" "	....	....	....	....	....	....	7	7	7	7	7

SLEEVE NUTS

(Manufactured by American Bridge Company)

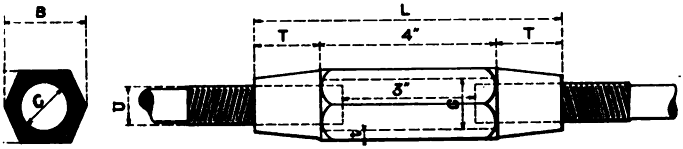


(Dimensions in Inches. For equivalents in Millimeters see page 639)

Diameter of Screw U	Length of Thread T	Length of Nut L	Short Diameter A	Long Diameter B	Inside Diameter C	Thickness t	Weight in Lbs.
7/8	1 1/2	7	1 5/8	1 7/8	1 1/4	1/4	3
1	1 1/2	7	1 5/8	1 7/8	1 1/4	1/4	3
1 1/8	1 3/4	7 1/2	2	2 5/16	1 3/8	5/16	4
1 1/4	1 3/4	7 1/2	2	2 5/16	1 3/8	5/16	4
1 3/8	2	8	2 3/8	2 3/4	1 5/8	3/8	5
1 1/2	2	8	2 3/8	2 3/4	1 5/8	3/8	6
1 5/8	2 1/4	8 1/2	2 3/4	3 3/16	1 7/8	7/16	8
1 3/4	2 1/4	8 1/2	2 3/4	3 3/16	1 7/8	7/16	9
1 7/8	2 1/2	9	3 1/8	3 5/8	2 1/8	1/2	10
2	2 1/2	9	3 1/8	3 5/8	2 1/8	1/2	11
2 1/8	2 3/4	9 1/2	3 1/2	4 1/16	2 3/8	9/16	14
2 1/4	2 3/4	9 1/2	3 1/2	4 1/16	2 3/8	9/16	15
2 3/8	3	10	3 7/8	4 1/2	2 5/8	5/8	18
2 1/2	3	10	3 7/8	4 1/2	2 5/8	5/8	19
2 3/4	3 1/4	10 1/2	4 1/4	4 15/16	2 7/8	11/16	23
2 7/8	3 1/2	11	4 5/8	5 3/8	3 1/8	3/4	27
3	3 1/2	11	4 5/8	5 3/8	3 1/8	3/4	28
3 1/4	3 3/4	11 1/2	5	5 13/16	3 3/8	13/16	35
3 1/2	4	12	5 3/8	6 1/4	3 5/8	7/8	40
3 3/4	4 1/4	12 1/2	5 3/4	6 11/16	3 7/8	15/16	47
4	4 1/2	13	6 1/8	7 1/16	4 1/8	1	55
4 1/4	4 3/4	13 1/2	6 1/2	7 1/2	4 3/8	1 1/16	65
4 1/2	5	14	6 7/8	7 15/16	4 5/8	1 1/16	75

SLEEVE NUTS.—*Continued*

(Manufactured by American Bridge Company)



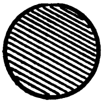
(Dimensions in Millimeters. For sizes in Inches see page 638)

Length of Thread T	Length of Nut L	Short Diameter A	Long Diameter B	Inside Diameter C	Thickness t	Weight in Kilos
38	178	41	48	29	6.3	1.36
38	178	41	48	29	6.3	1.36
45	190	51	59	35	7.9	1.81
45	190	51	59	35	7.9	1.81
51	203	60	70	41	9.5	2.27
51	203	60	70	41	9.5	2.72
57	216	70	81	48	11.1	3.63
57	216	70	81	48	11.1	4.08
63	229	79	92	54	12.7	4.54
63	229	79	92	54	12.7	4.99
70	241	89	103	60	14.3	6.35
70	241	89	103	60	14.3	6.80
76	254	99	114	67	15.9	8.17
76	254	99	114	67	15.9	8.62
83	267	108	125	73	17.5	10.43
89	279	117	137	79	19.0	12.25
89	279	117	137	79	19.0	12.70
95	292	127	148	86	20.6	15.88
102	305	137	159	92	22.2	18.15
108	317	146	170	98	23.8	21.32
114	330	156	179	105	25.4	24.95
121	343	165	191	111	27.0	29.49
127	356	175	202	121	27.0	34.02

STANDARD UPSETS

(As furnished by American Bridge Company)

ROUND BARS

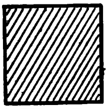


ROD			UPSET						
Diameter, Inches	Area, Square Inches	Weight per Foot, Pounds	Diameter, Inches	Length, Inches	Additional Length for Upset + 10%, Inches	Number of Threads per Inch	Diameter at Root of Thread, Inches	Area at Root of Thread, Square Inches	Excess over Area of Bar, Per Cent.
*3/4	.442	1.50	1	4	4	8	0.838	0.551	24.7
*7/8	.601	2.04	1 1/8	4	5	7	1.064	0.890	48.0
1	.785	2.67	1 3/8	4	4	6	1.158	1.054	34.2
1 1/8	.994	3.38	1 1/2	4	4	6	1.283	1.294	30.2
1 1/4	1.227	4.17	1 5/8	4	4	5 1/2	1.389	1.515	23.5
1 3/8	1.485	5.05	1 3/4	4	4	5	1.490	1.744	17.5
1 1/2	1.767	6.01	2	4 1/2	4 1/2	4 1/2	1.711	2.300	30.2
1 5/8	2.074	7.05	2 1/8	4 1/2	4	4 1/2	1.836	2.649	27.7
1 3/4	2.405	8.18	2 1/4	5	4	4 1/2	1.961	3.021	25.6
1 7/8	2.761	9.39	2 3/8	5	4	4 1/2	2.086	3.419	23.8
2	3.142	10.68	2 1/2	5 1/2	4	4	2.175	3.716	18.3
2 1/8	3.547	12.06	2 5/8	5 1/2	3 1/2	4	2.300	4.156	17.2
2 1/4	3.976	13.52	2 7/8	6	4 1/2	4	2.550	5.108	28.4
2 3/8	4.430	15.06	3	6	4 1/2	3 1/2	2.629	5.428	22.5
2 1/2	4.909	16.69	3 1/4	6 1/2	5 1/2	3 1/2	2.879	6.509	32.6
2 5/8	5.412	18.40	3 1/4	6 1/2	4 1/2	3 1/2	2.879	6.509	20.3
2 3/4	5.940	20.19	3 1/2	7	5 1/2	3 1/4	3.100	7.549	27.1
2 7/8	6.492	22.07	3 3/4	7	6	3	3.317	8.641	33.1
3	7.069	24.03	3 3/4	7	5	3	3.317	8.641	22.2
3 1/8	7.670	26.08	4	7 1/2	6	3	3.567	9.993	30.3
3 1/4	8.296	28.21	4	7 1/2	5	3	3.567	9.993	20.5
3 3/8	8.946	30.42	4 1/4	8	5 1/2	2 7/8	3.798	11 330	26.6
3 1/2	9.621	32.71	4 1/4	8	5	2 7/8	3.798	11.330	17.8
3 5/8	10.321	35.09	4 1/2	8 1/2	5 1/2	2 3/4	4.028	12.741	23.4
3 3/4	11.045	37.55	4 3/4	8 1/2	6	2 5/8	4.255	14.221	28.8
3 7/8	11.793	40.10	4 3/4	8 1/2	5 1/2	2 5/8	4.255	14.221	20.6

Upsets marked * are Special

For Metric equivalents of dimensions and weights in above table, see tables, pages 14 to 28.

STANDARD UPSETS.—*Continued*

SQUARE  **BARS**

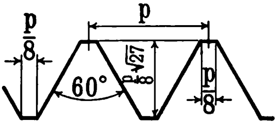
ROD		UPSET						
Area, Square Inches	Weight per Foot, Pounds	Diameter, Ins.	Length, Ins.	Additional Length for Upset + 10%, Inches	Number of Threads per Inch	Diameter at Root of Thread, Inches	Area at Root of Thread, Square Inches	Excess over Area of Bar, Per Cent.
.563	1.91	1⅛	4	4	7	0.939	0.693	23.2
.766	2.60	1¼	4	3½	7	1.064	0.890	16.2
1.000	3.40	1½	4	4	6	1.283	1.294	26.4
1.266	4.30	1⅝	4	3½	5½	1.389	1.515	19.7
1.563	5.31	1⅞	4½	4½	5	1.615	2.049	31.1
1.891	6.43	2	4½	4	4½	1.711	2.300	21.7
2.250	7.65	2¼	5	5	4½	1.961	3.021	34.3
2.641	8.98	2⅜	5	4½	4½	2.086	3.419	29.5
3.063	10.41	2½	5½	4½	4	2.175	3.716	21.3
3.516	11.95	2¾	5½	5	4	2.425	4.619	31.4
4.000	13.60	2⅞	6	5	4	2.550	5.108	27.7
4.516	15.35	3	6	4½	3½	2.629	5.428	20.2
5.063	17.21	3¼	6½	5½	3½	2.879	6.509	28.6
5.641	19.18	3½	7	6½	3¼	3.100	7.549	33.8
6.250	21.25	3¾	7	7	3	3.317	8.641	38.3
6.891	23.43	3¾	7	5½	3	3.317	8.641	25 4
7.563	25.71	4	7½	6½	3	3.567	9.993	32.1
8.266	28.10	4¼	8	7½	2⅞	3.798	11.330	37.1
9.000	30.60	4¼	8	6	2⅞	3.798	11.330	25.9
9.766	33.20	4½	8½	7	2¾	4.028	12.741	30.5
10.563	35.91	4¾	8½	7½	2⅝	4.255	14.221	34.6

Upsets marked * are Special

Metric equivalents of dimensions and weights in above table, see pages 14 to 28.

SHAPE OF THREAD

(Same as recommended by the Franklin Institute, 1864)



PITCH

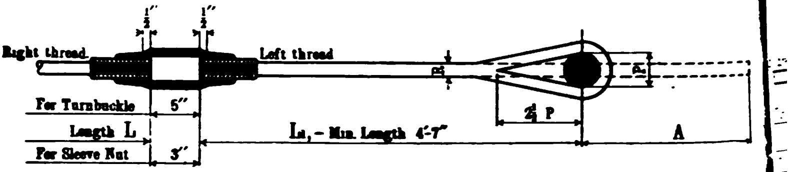
ne as recommended by American Railway Engineering and Maintenance
y Association, 1905)

er of Screw Ends	1″	1⅛″ and 1¼″	1⅜″ and up
of Threads per Inch	8	7	6

LOOP RODS

(Manufactured by American Bridge Company)

ALLOWANCE FOR LOOP



Maximum shipping length of Rod "L"=35 feet. $A = 4.17P + 5.89R$

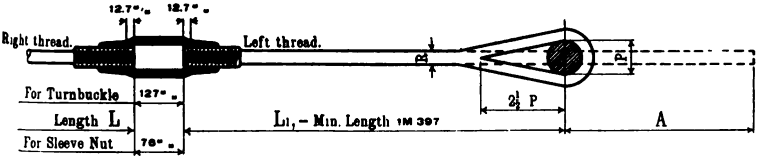
ADDITIONAL LENGTHS "A" IN FEET AND INCHES FOR ONE LOOP
(For Equivalents in Millimeters see page 643)

Diam. of Pin "P" Inches	Diameter or Side "R" of Rod										
	¾″	⅞″	1″	1⅛″	1¼″	1⅜″	1½″	1⅝″	1¾″	1⅞″	2″
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
1⅛	0- 9½	0-10	0-11	0-11½	......	......	......	......	......	......	......
1¼	0-10	0-10½	0-11½	1- 0	1- 1	......	......	......	......	......	......
1½	0-11	0-11½	1- 0½	1- 1	1- 2	1- 2½	......	......	......	......	......
1¾	1- 0	1- 0½	1- 1½	1- 2	1- 3	1- 3½	1- 4½	1- 5	1- 6	......	......
2	1- 1	1- 1½	1- 2½	1- 3	1- 4	1- 4½	1- 5½	1- 6	1- 7	1- 7½	1- 8½
2¼	1- 2	1- 3	1- 3½	1- 4½	1- 5	1- 5½	1- 6½	1- 7	1- 8	1- 8½	1- 9½
2½	1- 3	1- 4	1- 4½	1- 5½	1- 6	1- 7	1- 7½	1- 8	1- 9	1- 9½	1-10½
2¾	1- 4	1- 5	1- 5½	1- 6½	1- 7	1- 8	1- 8½	1- 9½	1-10	1-11	1-11½
3	1- 5	1- 6	1- 6½	1- 7½	1- 8	1- 9	1- 9½	1-10½	1-11	2- 0	2- 0½
*3¼	1- 6	1- 7	1- 7½	1- 8½	1- 9	1-10	1-10½	1-11½	2- 0	2- 1	2- 1½
3½	1- 7½	1- 8	1- 8½	1- 9½	1-10	1-11	1-11½	2- 0½	2- 1	2- 2	2- 2½
*3¾	1- 8½	1- 9	1-10	1-10½	1-11	2- 0	2- 0½	2- 1½	2- 2	2- 3	2- 3½
4	1- 9½	1-10	1-11	1-11½	2- 0½	2- 1	2- 2	2- 2½	2- 3	2- 4	2- 4½
*4¼	......	1-11	2- 0	2- 0½	2- 1½	2- 2	2- 3	2- 3½	2- 4½	2- 5	2- 6
4½	......	2- 0	2- 1	2- 1½	2- 2½	2- 3	2- 4	2- 4½	2- 5½	2- 6	2- 7
*4¾	......	2- 1	2- 2	2- 2½	2- 3½	2- 4	2- 5	2- 5½	2- 6½	2- 7	2- 8
5	..	2- 2½	2- 3	2- 3½	2- 4½	2- 5	2- 6	2- 6½	2- 7½	2- 8	2- 9
*5¼	...	......	2- 4	2- 5	2- 5½	2- 6	2- 7	2- 7½	2- 8½	2- 9	2-10
5½	....	......	2- 5	2- 6	2- 6½	2- 7½	2- 8	2- 9	2- 9½	2-10	2-11
*5¾	....	......	2- 6	2- 7	2- 7½	2- 8½	2- 9	2-10	2-10½	2-11½	3- 0
6	. ..	.....	2- 7	2- 8	2- 8½	2- 9½	2-10	2-11	2-11½	3- 0½	3- 1
*6¼	....	....	.....	2- 9	2- 9½	2-10½	2-11	3- 0	3- 0½	3- 1½	3- 2
6½	....	.....	.....	2-10	2-10½	2-11½	3- 0	3- 1	3- 1½	3- 2½	3- 3
*6¾			..	2-11	3- 0	3- 0½	3- 1	3- 2	3- 2½	3- 3½	3- 4
7				3- 0	3- 1	3- 1½	3- 2½	3- 3	3- 3½	3- 4½	3- 5

Pins marked * are Special

Loop Rods.—*Continued*

Allowance for Loop.—*Continued*



Maximum shipping length of Rod "L"=10.668m. A=4.17P+5.89R

Additional Length "A" in Millimeters for One Loop

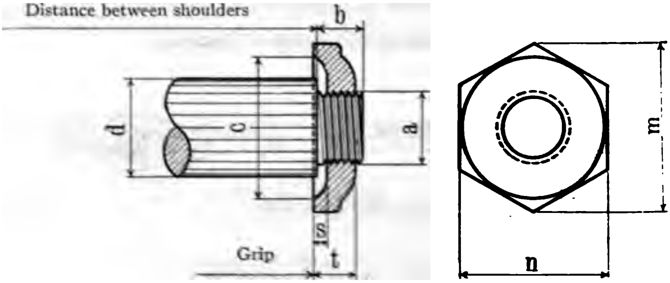
(For lengths in feet and inches see page 642)

Diam. of Pin "P" m/m	Diameter or Side "R" of Rod—Millimeters										
	19	22	25	29	32	35	38	41	44	48	51
29	241	254	279	292	......	......	......	......	......	......	......
32	254	267	292	305	330	......	......	......	......	......	......
38	279	292	318	330	356	368	......	......	......	......	......
44	305	318	343	356	381	394	419	432	457	......	......
51	330	343	368	381	406	419	445	457	483	495	521
57	356	381	394	419	432	445	470	483	508	521	546
64	381	406	419	445	457	483	495	508	533	546	572
70	406	432	445	470	483	508	521	546	559	584	597
76	432	457	470	495	508	533	546	572	584	610	622
*83	457	483	495	521	533	559	572	597	610	635	648
89	495	508	521	546	559	584	597	622	635	660	673
*95	521	533	559	572	584	610	622	648	660	686	699
102	546	559	584	597	622	635	660	673	686	711	724
*108	......	584	610	622	648	660	686	699	724	737	762
114	......	610	635	648	673	686	711	724	749	762	787
*121	......	635	660	673	699	711	737	749	775	787	813
127	......	673	686	699	724	737	762	775	800	813	838
*133	......	......	711	737	749	762	787	800	826	838	864
140	......	......	737	762	775	800	813	838	851	864	889
*146	......	......	762	787	800	826	838	864	876	902	914
152	......	......	787	813	826	851	864	889	902	927	940
*159	......	......	......	838	851	876	889	914	927	953	965
165	......	......	......	864	876	902	914	940	953	978	991
*171	......	......	......	889	914	927	940	965	978	1003	1016
178	......	......	......	914	940	953	978	991	1003	1029	1041

Pins marked * are Special

PINS WITH NUTS

(Manufactured by American Bridge Company)



Shape of thread same as recommended by the Franklin Institute, 1864.
Pitch equals six threads per inch. See page 641.
Grip equals distance between nuts. For distance between shoulders add to grip the amou given in table For pins up to 10" diam. pin hole $\frac{1}{50}$" larger than diam. of pin, unless otherw specified.
For pins above 10" a hole should be bored through pin and pin caps used, these caps to held by rod going through pin.

DIMENSIONS IN INCHES

Diameter of Pin d			Pin: Thread a	Thread b	Add to Grip	Nut: Thickness t	Diam. n	Diam. m	Diam. C	Depth S	Diam. rough hole	Weight in pounds	P t
[illegible]	2	2½	1½	1	⅜	¾	2⅞	3⅜	2⅝	¼	1 5/16	1 1	P
[illegible]	[illegible]	[illegible]	2	1¼	⅜	1	3 9/16	4⅛	3⅛	¼	1 13/16	1.7	P
3	[illegible]	[illegible]	2½	1¼	⅜	1¼	4 5/16	5	3⅜	⅜	2 5/16	2.5	P
[illegible]	[illegible]	4	3	1½	½	1½	4⅞	5¾	4⅜	⅜	2 13/16	3.7	P
*4[illegible]	4[illegible]	*4[illegible]	3½	1½	½	1½	5[illegible]	6⅝	5¼	½	3 5/16	4.6	P
[illegible]	[illegible]	*5[illegible]	4	1½	½	1½	6[illegible]	7 3/16	5¾	½	3 13/16	6.2	P
5[illegible]	*[illegible]	6	4½	1½	½	1½	7[illegible]	8⅛	6½	½	4 5/16	7.8	P
[illegible]	*[illegible]	*6[illegible]	5	1¾	⅝	1½	7[illegible]	8⅞	7	⅝	4 13/16	9.9	P
[illegible]	*[illegible]	[illegible]	5½	2	⅝	1½	8[illegible]	9⅜	7½	⅝	5 5/16	11.8	P
[illegible]	*[illegible]	*7[illegible]	5½	2	⅝	1½	8[illegible]	10	8	⅝	5 5/16	14.3	P
*7[illegible]	8	[illegible]	6	2¼	⅝	2[illegible]	9[illegible]	10[illegible]	8¾	¾	5 13/16	18.6	P
*8[illegible]		9	6	2¼	⅝	2[illegible]	10[illegible]	11[illegible]	9⅝	¾	5 13/16	23.8	P
*9[illegible]		10	6	2[illegible]	⅝	2[illegible]	11[illegible]	13	10⅝	¾	5 13/16	31.1	P

DIMENSIONS IN MILLIMETERS

Diameter of Pin d			Pin: Thread a	Thread b	Add to Grip	Nut: Thickness t	Diam. n	Diam. m	Diam. C	Depth S	Diam. rough hole	Weight in Kilos
	[illegible]	[illegible]	38	25	9.53	[illegible]	73	86	67	6.35	33	0.500
	[illegible]	[illegible]	[illegible]	[illegible]	9.53	[illegible]	90	105	79	6.35	46	0.771
[illegible]	[illegible]	[illegible]	64	[illegible]	9.53	[illegible]	110	127	86	9.53	59	1.134
	[illegible]	[illegible]	[illegible]	[illegible]	12.70	[illegible]	124	146	111	9.53	71	1.678
*[illegible]	[illegible]	*[illegible]	89	[illegible]	12.70	[illegible]	148	168	133	12.70	84	2.087
	[illegible]	*[illegible]	102	41	12.70	[illegible]	[illegible]	[illegible]	146	12.70	97	2.812
[illegible]	*[illegible]	[illegible]	114	44	12.70	41	[illegible]	206	165	16	110	3.538
	*[illegible]	*[illegible]	[illegible]	45	16	44	[illegible]	[illegible]	178	16	122	4.491
	*[illegible]	*[illegible]	140	[illegible]	16	45	[illegible]	[illegible]	[illegible]	16	135	5.352
	*[illegible]	*[illegible]	140	[illegible]	16	45	[illegible]	[illegible]	[illegible]	19	135	6.486
*[illegible]	[illegible]	*[illegible]	152	[illegible]	16	54	[illegible]	[illegible]	[illegible]	19	148	8.437
*[illegible]		[illegible]	152	[illegible]	16	54	[illegible]	302	244	19	148	10.796
*[illegible]		[illegible]	152	[illegible]	16	[illegible]	[illegible]	[illegible]	270	19	148	14.107

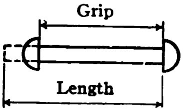
Pins marked * are Special.

RIVETS

(Manufactured by American Bridge Company)

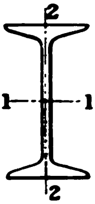
Rivet Lengths and Approximate Weights per Hundred for Various Grips

Weights given are for rivets before driving. Dimensions are in inches and weights in pounds; for metric equivalents, see tables, pages 14 to 28.



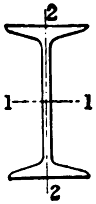
Grip	½″		⅝″		¾″		⅞″		1″	
	L	Weight per 100	L	Weight per 100	L	Weight per 100	L	Weight per 100	L	Weight per 100
½	1½	13	1¾	25	1⅞	39	2	58	2⅛	82
⅝	1⅝	14	1⅞	26	2	41	2⅛	60	2¼	85
¾	1¾	15	2	27	2⅛	43	2¼	62	2⅜	88
⅞	1⅞	15	2⅛	28	2¼	44	2⅜	64	2½	91
1	2	16	2¼	29	2⅜	46	2½	67	2⅝	93
1⅛	2⅛	17	2⅜	30	2½	47	2⅝	69	2¾	96
1¼	2¼	18	2½	31	2⅝	49	2¾	71	2⅞	99
1⅜	2⅜	18	2⅝	32	2¾	50	2⅞	73	3	102
1½	2⅝	20	2⅞	35	3	54	3⅛	77	3¼	107
1⅝	2¾	20	3	36	3⅛	55	3¼	79	3⅜	110
1¾	3	22	3¼	38	3⅜	58	3½	84	3⅝	116
1⅞	3⅛	22	3⅜	39	3½	60	3⅝	86	3¾	118
2	3¼	23	3½	40	3⅝	61	3¾	88	3⅞	121
2⅛	3⅜	24	3⅝	41	3¾	63	3⅞	90	4	124
2¼	3½	24	3¾	42	3⅞	64	4	92	4⅛	127
2⅜	3⅝	25	3⅞	43	4	66	4⅛	94	4¼	130
2½	3¾	26	4	44	4⅛	68	4¼	96	4⅜	132
2⅝	3⅞	27	4⅛	45	4¼	69	4⅜	98	4½	135
2¾	4	27	4¼	47	4⅜	71	4½	101	4⅝	138
2⅞	4⅛	28	4⅜	48	4½	72	4⅝	103	4¾	141
3	4⅜	29	4⅝	50	4¾	75	4⅞	107	5	146
3⅛	4½	30	4¾	51	4⅞	77	5	109	5⅛	149
3¼	4⅝	31	4⅞	52	5	78	5⅛	111	5¼	152
3⅜	4¾	31	5	53	5⅛	80	5¼	113	5⅜	155
3½	4⅞	32	5⅛	54	5¼	82	5⅜	115	5½	157
3⅝	5	33	5¼	55	5⅜	83	5½	118	5⅝	160
3¾	5⅛	34	5⅜	56	5½	85	5⅝	120	5¾	163
3⅞	5¼	34	5½	57	5⅝	86	5¾	122	5⅞	166
4	5⅜	35	5⅝	58	5¾	88	5⅞	124	6	169
4⅛	5⅝	36	5⅞	61	6	91	6⅛	128	6¼	174
4¼	5¾	37	6	62	6⅛	93	6¼	130	6⅜	177
4⅜	6	38	6¼	64	6⅜	96	6½	135	6⅝	182
4½	6⅛	39	6⅜	65	6½	97	6⅝	137	6¾	185
4⅝	6¼	40	6½	66	6⅝	99	6¾	139	6⅞	188
4¾	6⅜	40	6⅝	67	6¾	100	6⅞	141	7	191
4⅞	6½	41	6¾	68	6⅞	102	7	143	7⅛	194
5	6⅝	42	6⅞	69	7	104	7⅛	145	7¼	196
5⅛					7⅛	105	7¼	147	7⅜	199
5¼					7¼	107	7⅜	149	7½	202
5⅜					7⅜	108	7½	152	7⅝	205
5½					7⅝	111	7¾	156	7⅞	210
5⅝					7¾	113	7⅞	158	8	213
5¾					7⅞	114	8	160	8⅛	216
5⅞					8	116	8⅛	162	8¼	219
6					8⅛	118	8¼	164	8⅜	221

ELEMENTS OF BEAMS



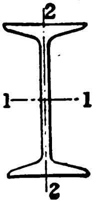
Section Index	Depth of Beam	Weight per Foot	Area of Section	Width of Flange	Thickness of Web	Axis 1-1			Axis 2-2		
						I	r	S	I	r	S
	In.	Pounds	In.^{2}	In.	In.	In.^{4}	In.	In.^{3}	In.^{4}	In.	In.^{3}
B 61	27	90.0	26.33	9.000	0.524	2958.3	10.60	219.1	75.3	1.69	16.7
B 24	24	115.0	33.98	8.000	0.750	2955.5	9.33	246.3	83.2	1.57	20.8
		110.0	32.48	7.938	0.688	2883.5	9.42	240.3	81.0	1.58	20.4
		105.0	30.98	7.875	0.625	2811.5	9.53	234.3	78.9	1.60	20.0
B 1	24	100.0	29.41	7.254	0.754	2379.6	9.00	198.3	48.6	1.28	13.4
		95.0	27.94	7.193	0.693	2309.0	9.09	192.4	47.1	1.30	13.1
		90.0	26.47	7.131	0.631	2238.4	9.20	186.5	45.7	1.31	12.8
		85.0	25.00	7.070	0.570	2167.8	9.31	180.7	44.4	1.33	12.6
		80.0	23.32	7.000	0.500	2087.2	9.46	173.9	42.9	1.36	12.3
B 62	24	74.0	21.70	9.000	0.476	1950.1	9.48	162.5	61.2	1.68	13.6
B 63	21	60.5	17.68	8.250	0.428	1235.5	8.36	117.7	43.5	1.57	10.6
B 2	20	100.0	29.41	7.284	0.884	1655.6	7.50	165.6	52.7	1.34	14.5
		95.0	27.94	7.210	0.810	1606.6	7.58	160.7	50.8	1.35	14.1
		90.0	26.47	7.137	0.737	1557.6	7.67	155.8	49.0	1.36	13.7
		85.0	25.00	7.063	0.663	1508.5	7.77	150.9	47.3	1.37	13.4
		80.0	23.73	7.000	0.600	1466.3	7.86	146.6	45.8	1.39	13.1
B 3	20	75.0	22.06	6.399	0.649	1268.8	7.58	126.9	30.3	1.17	9.5
		70.0	20.59	6.325	0.575	1219.8	7.70	122.0	29.0	1.19	9.2
		65.0	19.08	6.250	0.500	1169.5	7.83	117.0	27.9	1.21	8.9
B 81	18	90.0	26.47	7.245	0.807	1260.4	6.90	140.0	52.0	1.40	14.4
		85.0	25.00	7.163	0.725	1220.7	6.99	135.6	50.0	1.42	14.0
		80.0	23.53	7.082	0.644	1181.0	7.09	131.2	48.1	1.43	13.6
		75.0	22.05	7.000	0.562	1141.3	7.19	126.8	46.2	1.45	13.2
B 80	18	70.0	20.59	6 259	0.719	921.2	6.69	102.4	24.6	1.09	7.9
		65.0	19.12	6.177	0.637	881.5	6.79	97.9	23.5	1.11	7.6
		60.0	17.65	6.095	0.555	841.8	6.91	93.5	22.4	1.13	7.3
		55.0	15.93	6.000	0.460	795.6	7.07	88.4	21.2	1.15	7.1
B 64	18	48.0	14.08	7.500	0.380	737.1	7.23	81.9	30.0	1.46	8.0

ELEMENTS OF BEAMS.—*Continued*



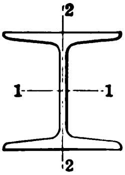
Section Index	Depth of Beam	Weight per Foot	Area of Section	Width of Flange	Thickness of Web	Axis 1-1			Axis 2-2		
						I	r	S	I	r	S
	In.	Pounds	In.^{2}	In.	In.	In.^{4}	In.	In.^{3}	In.^{4}	In.	In.^{3}
B 5	15	75.0	22.06	6.292	0.882	691.2	5.60	92.2	30.7	1.18	9.8
		70.0	20.59	6.194	0.784	663.7	5.68	88.5	29.0	1.19	9.4
		65.0	19.12	6.096	0.686	636.1	5.77	84.8	27.4	1.20	9.0
		60.0	17.67	6.000	0.590	609.0	5.87	81.2	26.0	1.21	8.7
B 7	15	55.0	16.18	5.746	0.656	511.0	5.62	68.1	17.1	1.02	5.9
		50.0	14.71	5.648	0.558	483.4	5.73	64.5	16.0	1.04	5.7
		45.0	13.24	5.550	0.460	455.9	5.87	60.8	15.1	1.07	5.4
		42.0	12.48	5.500	0.410	441.8	5.95	58.9	14.6	1.08	5.3
B 65	15	37.5	10.91	6.750	0.332	405.5	6.10	54.1	19.9	1.35	5.9
B 8	12	55.0	16.18	5.611	0.821	321.0	4.45	53.5	17.5	1.04	6.2
		50.0	14.71	5.489	0.699	303.4	4.54	50.6	16.1	1.05	5.9
		45.0	13.24	5.366	0.576	285.7	4.65	47.6	14.9	1.06	5.6
		40.0	11.84	5.250	0.460	269.0	4.77	44.8	13.8	1.08	5.3
B 9	12	35.0	10.29	5.086	0.436	228.3	4.71	38.0	10.1	0.99	4.0
		31.5	9.26	5.000	0.350	215.8	4.83	36.0	9.5	1.01	3.8
B 66	12	28.0	8.15	6.000	0.284	199.4	4.95	33.2	12.6	1.24	4.2
B 11	10	40.0	11.76	5.099	0.749	158.7	3.67	31.7	9.5	0.90	3.7
		35.0	10.29	4.952	0.602	146.4	3.77	29.3	8.5	0.91	3.4
		30.0	8.82	4.805	0.455	134.2	3.90	26.8	7.7	0.93	3.2
		25.0	7.37	4.660	0.310	122.1	4.07	24.4	6.9	0.97	3.0
B 67	10	22.25	6.54	5.500	0.252	113.6	4.17	22.7	9.0	1.17	3.3
B 13	9	35.0	10.29	4.772	0.732	111.8	3.29	24.8	7.3	0.84	3.1
		30.00	8.82	4.609	0.569	101.9	3.40	22.6	6.4	0.85	2.8
		25.0	7.35	4.446	0.406	91.9	3.54	20.4	5.7	0.88	2.5
		21.0	6.31	4.330	0.290	84.9	3.67	18.9	5.2	0.90	2.4
B 15	8	25.5	7.50	4.271	0.541	68.4	3.02	17.1	4.8	0.80	2.2
		23.0	6.76	4.179	0.449	64.5	3.09	16.1	4.4	0.81	2.1
		20.5	6.03	4.087	0.357	60.6	3.17	15.2	4.1	0.82	2.0
		18.0	5.33	4.000	0.270	56.9	3.27	14.2	3.8	0.84	1.9
B 68	8	17.5	5.12	5.000	0.220	58.4	3.38	14.6	6.2	1.10	2.5

ELEMENTS OF BEAMS.—*Continued*



Section Index	Depth of Beam	Weight per Foot	Area of Section	Width of Flange	Thickness of Web	Axis 1-1			Axis 2-2		
						I	r	S	I	r	S
	In.	Pounds	In.^{2}	In.	In.	In.^{4}	In.	In.^{3}	In.^{4}	In.	In.^{3}
B 17	7	20.0	5.88	3.868	0.458	42.2	2.68	12.1	3.2	0.74	1.7
		17.5	5.15	3.763	0.353	39.2	2.76	11.2	2.9	0.76	1.6
		15.0	4.42	3.660	0.250	36.2	2.86	10.4	2.7	0.78	1.5
B 19	6	17.25	5.07	3.575	0.475	26.2	2.27	8.7	2.4	0.68	1.3
		14.75	4.34	3.452	0.352	24.0	2.35	8.0	2.1	0.69	1.2
		12.25	3.61	3.330	0.230	21.8	2.46	7.3	1.9	0.72	1.1
B 21	5	14.75	4.34	3.294	0.504	15.2	1.87	6.1	1.7	0.63	1.0
		12.25	3.60	3.147	0.357	13.6	1.94	5.5	1.5	0.63	0.92
		9.75	2.87	3.000	0.210	12.1	2.05	4.8	1.2	0.65	0.82
B 23	4	10.5	3.09	2.880	0.410	7.1	1.52	3.6	1.0	0.57	0.70
		9.5	2.79	2.807	0.337	6.8	1.55	3.4	0.93	0.58	0.66
		8.5	2.50	2.733	0.263	6.4	1.59	3.2	0.85	0.58	0.62
		7.5	2.21	2.660	0.190	6.0	1.64	3.0	0.77	0.59	0.58
B 77	3	7.5	2.21	2.521	0.361	2.9	1.15	1.9	0.60	0.52	0.48
		6.5	1.91	2.423	0.263	2.7	1.19	1.8	0.53	0.52	0.44
		5.5	1.63	2.330	0.170	2.5	1.23	1.7	0.46	0.53	0.40

ELEMENTS OF H BEAMS



Section Index	Depth of Beam	Weight per Foot	Area of Section	Width of Flange	Thickness of Web	Axis 1-1			Axis 2-2		
						I	r	S	I	r	S
	In.	Pounds	In.^{2}	In.	In.	In.^{4}	In.	In.^{3}	In.^{4}	In.	In.^{3}
H 4	8	34.0	10.00	8.0	.375	115.4	3.40	28.9	35.1	1.87	8.8
H 3	6	23.8	7.00	6.0	.313	45.1	2.54	15.0	14.7	1.45	4.9
H 2	5	18.7	5.50	5.0	.313	23.8	2.08	9.5	7.9	1.20	3.1
H 1	4	13.6	4.00	4.0	.313	10.7	1.63	5.3	3.6	0.95	1.8

SAFE LOADS FOR SECTIONS USED AS BEAMS

EXPLANATION OF TABLES ON PAGES 652 TO 659

These tables of safe loads for beams under conditions of transverse loading, give the uniformly distributed safe loads in thousands of pounds for spans customary in bridge and building construction based upon an extreme fiber stress of 16,000 pounds per square inch. The loads in all cases include the weight of the section, which should be deducted in order to arrive at the net load which the section will support.

In addition to these usual tables of safe loads, there follow, on the same basis, tables of the allowable uniform load in pounds per foot on beams for various span lengths, which may be used in proportioning the floor systems of buildings. The choice between various weights and depths of sections for any given span or any uniform load per running foot may be made on inspection.

It is assumed in all cases that the loads are applied normal to the neutral axis 1–1 (see page 646), and that the beam deflects vertically in the plane of bending only. If the conditions of loading involve the introduction of forces outside this plane of loading, the allowable safe loads must be determined from the general theory of flexure in accordance with the mode of application of the load and its character. In all such cases of eccentric loading, the actual safe loads would be considerably lower than the tabulated safe loads which have been based upon the most favorable conditions of loading.

Vertical Deflection of Beams. In the case of beams intended to carry plastered ceilings, experience indicates that the vertical deflection to avoid cracking the plaster should be limited to not more than $\frac{1}{360}$ of the span length. This span limit for steel beams is approximately in feet twice the depth in inches and is indicated in the tables by the lower dotted line. Beams intended for such purposes should not be used for greater spans unless the allowable tabular safe load exceeds the actual load to be supported. As the dead load of the floor is supported by the beams before the plaster is applied, only the deflection due to the live load really needs to be considered.

SAFE LOADS FOR SECTIONS USED AS BEAMS.—*Continued*

To find the deflection in inches of beams transversely loaded to an extreme fiber stress of 16,000 pounds per square inch, divide the coefficient of deflection shown on pages 652 to 656 by the depth of the beam in inches.

Lateral Deflection of Beams. The tabular safe loads are based on the assumption that the compression flanges of the various sections are secured against lateral deflection by the use of tie rods or by other means at proper intervals. According to the Construction Specifications, page 550 the lateral unsupported length of beams and girders should not exceed forty times the width of the compression flanges. When the unsupported length exceeds ten times the width, the tabular safe loads should be reduced in accordance with the ratios given in the following table in order to insure that the stresses in the compression flanges should not exceed the allowed safe unit stress:

Length of Span	Allowable Safe Load	Length of Span	Allowable Safe Load
5 x flange width	Full tabular load	25 x flange width	71.9% tabular load
10 x " "	" " "	30 x " "	62.5% " "
15 x " "	90.6% tabular load	35 x " "	53.1% " "
20 x " "	81.2% " "	40 x " "	43.8% " "

In addition to this lateral deflection which is induced within the beam by the action of pure bending stresses, lateral deflection may be induced by the thrust of floor arches or other loading acting on an axis perpendicular to the line of principal bending stress. The thrust of these arches should either be neutralized by tie rods, or the safe carrying capacity of the beam should be computed in accordance with the general formulas of flexure to provide for the combined stresses due to the action of both vertical and horizontal forces; that is to say, the safe loads should be figured around both the horizontal and vertical neutral axes and the unit stress computed so as not to exceed 16,000 pounds per square inch.

Effect of Impact on Stresses. The formulas upon which the tables of safe loads are based assume all loads to be quiescent or static. The effect of moving loads may be taken care of either by reducing the allowable unit stresses, or else by increasing the theoretical loads. See Construction Specifications, page 548, paragraph 2.

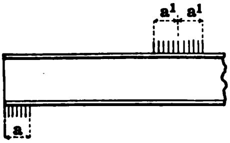
Shearing Stresses. The safe load tables for beams are computed solely with reference to safe unit stresses due to flexure, and the safe load uniformly distributed on the spans given will not produce average shearing stresses in the web greater than the 10,000 pounds per square inch allowed by the Con-

Safe Loads for Sections Used as Beams.—*Continued*

struction Specifications. When, however, beams are loaded with heavy loads concentrated near the supports, or when beams of short span are loaded with uniformly distributed loads to their full carrying capacity as regards flexure, the bending moments may be small in comparison with the reactions at the supports, and the beams may fail along the neutral plane as a result of longitudinal shearing stresses, or may buckle as a result of the combined longitudinal and vertical web stresses. On such spans the safe shearing or buckling strength of the web may limit the carrying capacity of the beam rather than the resistance of the flanges to bending stresses.

Buckling Values of Beam Webs. The vertical shearing stresses or the vertical compressive components of the web stress may under some conditions exceed the safe resistance of the beam to buckling, and there remains the possibility that a web or web plate which is amply secure as against the safe allowed shear of 10,000 pounds per square inch will not be of sufficient strength when considered as a column. In such cases provision must be made for security against buckling either in the way of stiffeners or by increasing the thickness of the web or web plate.

A series of experiments have been carried out on beams of various depths and web thicknesses to arrive at a basis for a simpler method of computation to use in the investigation of the safe buckling resistance of beams with unsupported webs, and from these experiments the following formulas have been deduced:



$$\text{Safe end reaction } R = f_b \times t\left(a + \frac{d}{4}\right)$$

$$\text{Safe interior load } W = 2\,f_b \times t\left(a^1 + \frac{d}{4}\right)$$

In these formulas R is the end reaction, W the concentrated load, t the web thickness, d the depth of the beam, a^1 half the distance over which the concentrated load is applied and a the whole distance over which the end reaction is applied, while f_b is the safe resistance of the web to buckling in pounds per square inch by the formula $19000-100\,d/2r$ ($d/2=1$ in column formula).

The first formula is general and applies to any condition of loading. The second formula covers the case of a single load concentrated at the center of a span; it can be extended to cover a system of concentrated loads provided the sum of the distance a^1 is not less than a.

BEAM SAFE LOADS

BEAMS

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Maximum Bending Stress, 16,000 Pounds per Square Inch

Span in Feet	Depth and Weight of Sections											Coefficient of Deflection
	27 In.	24 Inch									21 In.	
	90 lbs.	115 lbs.	110 lbs.	105 lbs.	100 lbs.	95 lbs.	90 lbs.	85 lbs.	80 lbs.	74 lbs.	60½ lbs.	
6					361.9 352.5	332.6	302.9				179.8	0.60
7		360.0	330.2		302.2	293.2	284.2	273.6	240.0	225.3	179.3	0.81
8	283.0	328.4	320.4	300.0	264.4	256.6	248.7	240.9	231.9	216.7	156.9	1.06
9	259.3	291.9	284.8	277.7	235.0	228.0	221.1	214.1	206.1	192.6	139.5	1.34
10	233.4	262.7	256.3	249.9	211.5	205.2	199.0	192.7	185.5	173.3	125.5	1.66
11	212.2	238.8	233.0	227.2	192.3	186.6	180.9	175.2	168.7	157.6	114.1	2.00
12	194.5	218.9	213.6	208.3	176.3	171.0	165.8	160.6	154.6	144.5	104.6	2.38
13	179.5	202.1	197.2	192.2	162.7	157.9	153.1	148.2	142.7	133.3	96.5	2.80
14	166.7	187.7	183.1	178.5	151.1	146.6	142.1	137.6	132.5	123.8	89.7	3.24
15	156.6	175.1	170.9	166.6	141.0	136.8	132.6	128.5	123.7	115.6	83.7	3.72
16	145.9	164.2	160.2	156.2	132.2	128.3	124.4	120.4	116.0	108.3	78.4	4.24
17	137.3	154.5	150.8	147.0	124.4	120.7	117.0	113.4	109.1	102.0	73.8	4.78
18	129.7	146.0	142.4	138.8	117.5	114.0	110.5	107.1	103.1	96.3	69.7	5.36
19	122.8	138.3	134.9	131.5	111.3	108.0	104.7	101.4	97.6	91.2	66.1	5.98
20	116.7	131.4	128.2	125.0	105.8	102.6	99.5	96.3	92.8	86.7	62.8	6.62
21	111.1	125.1	122.1	119.0	100.7	97.7	94.7	91.8	88.3	82.5	59.8	7.30
22	106.1	119.4	116.5	113.6	96.1	93.3	90.4	87.6	84.3	78.8	57.1	8.01
23	101.5	114.2	111.4	108.7	92.0	89.2	86.5	83.8	80.7	75.4	54.6	8.76
24	97.3	109.5	106.8	104.1	88.1	85.5	82.9	80.3	77.3	72.2	52.3	9.53
25	93.4	105.1	102.5	100.0	84.6	82.1	79.6	77.1	74.2	69.3	50.2	10.35
26	89.8	101.0	98.6	96.1	81.4	78.9	76.5	74.1	71.4	66.7	48.3	11.19
27	86.4	97.3	94.9	92.6	78.3	76.0	73.7	71.4	68.7	64.2	46.5	12.07
28	83.4	93.8	91.5	89.3	75.5	73.3	71.1	68.8	66.3	61.9	44.8	12.98
29	80.5	90.6	88.4	86.2	72.9	70.8	68.6	66.4	64.0	59.8	43.3	13.92
30	77.8	87.6	85.4	83.3	70.5	68.4	66.3	64.2	61.8	57.8	41.8	14.90
31	75.3	84.7	82.7	80.6	68.2	66.2	64.2	62.2	59.8	55.9	40.5	15.91
32	72.9	82.1	80.1	78.1	66.1	64.1	62.2	60.2	58.0	54.2	39.2	16.95
33	70.7	79.6	77.7	75.7	64.1	62.2	60.3	58.4	56.2	52.5	38.0	18.03
34	68.6	77.3	75.4	73.5	62.2	60.4	58.5	56.7	54.6	51.0	36.9	19.13
35	66.7	75.1	73.2	71.4	60.4	58.6	56.8	55.1	53.0	49.5	35.9	20.28
36	64.8	73.0	71.2	69.4	58.8	57.0	55.3	53.5	51.5	48.2	34.9	21.45
37	63.1	71.0	69.3	67.5	57.2	55.5	53.8	52.1	50.1	46.8	33.9	22.66
38	61.4	69.1	67.5	65.8	55.7	54.0	52.4	50.7	48.8	45.6	33.0	23.90
39	59.8	67.4	65.7	64.1	54.2	52.6	51.0	49.4	47.6	44.4	32.2	25.18
40	58.4	65.7	64.1	62.5	52.9	51.3	49.7	48.2	46.4	43.3	31.4	26.48
41	56.9	64.1	62.5	61.0	51.6	50.1	48.5	47.0	45.3	42.3	30.6	27.82
42	55.6	62.6	61.0	59.5	50.4	48.9	47.4	45.9	44.2	41.3	29.9	29.20
43	54.3	61.1	59.6	58.1	49.2	47.7	46.3	44.8	43.1	40.3	29.2	30.60
44	53.0	59.7	58.3	56.8	48.1	46.6	45.2	43.8	42.2	39.4	28.5	32.04
45	51.9	58.4	57.0	55.5	47.0	45.6	44.2	42.8	41.2	38.5		33.52
46	50.7	57.1	55.7	54.3	46.0	44.6	43.3	41.9	40.3	37.7		35.02
47	49.7	55.9	54.1	53.2	45.0	43.7	42.3	41.0	39.5	36.9		36.56
48	48.6	54.7	53.4	52.1	44.1	42.8	41.5	40.1	38.7	36.1		38.14
49	47.6	53.6	52.3	51.0	43.2	41.9	40.6	39.3	37.9	35.4		39.74
50	46.7	52.5	51.3	50.0	42.3	41.0	39.8	38.5	37.1	34.7		41.38

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.

BEAM SAFE LOADS.—*Continued*

BEAMS

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Maximum Bending Stress, 16,000 Pounds per Square Inch

Span in Feet	Depth and Weight of Sections												Coefficient of Deflection
	20 Inch								18 Inch				
	100 lbs.	95 lbs.	90 lbs.	85 lbs.	80 lbs.	75 lbs.	70 lbs.	65 lbs.	90 lbs.	85 lbs.	80 lbs.	75 lbs.	
	353.6												
5	353.2												0.41
		324.6	294.8			259.6	230.0		290.5	261.0			
				265.2	240.0			200.0			231.8	202.3	
6	294.3	285.6	276.9			225.6	216.8		249.0	241.1			0.60
7	252.3	244.8	237.7	229.9	223.4	193.3	185.9	178.2	213.4	206.7	200.0	193.2	0.81
8	220.7	214.2	207.7	201.1	195.5	169.2	162.6	155.9	186.7	180.8	175.0	169.1	1.06
9	196.2	190.4	184.6	178.8	173.8	150.4	144.6	138.6	166.0	160.7	155.5	150.3	1.34
10	176.6	171.4	166.1	160.9	156.4	135.3	130.1	124.7	149.4	144.7	140.0	135.3	1.66
11	160.5	155.8	151.0	146.3	142.2	123.0	118.3	113.4	135.8	131.5	127.2	123.0	2.00
12	147.2	142.8	138.5	134.1	130.3	112.8	108.4	104.0	124.5	120.6	116.6	112.7	2.38
13	135.8	131.8	127.8	123.8	120.3	104.1	100.1	96.0	114.9	111.3	107.7	104.1	2.80
14	126.1	122.4	118.7	114.9	111.7	96.7	92.9	89.1	106.7	103.3	100.0	96.6	3.24
15	117.7	114.2	110.8	107.3	104.3	90.2	86.7	83.2	99.6	96.4	93.3	90.2	3.72
16	110.4	107.1	103.8	100.6	97.7	84.6	81.3	78.0	93.4	90.4	87.5	84.5	4.24
17	103.9	100.8	97.7	94.1	92.0	79.6	76.5	73.4	87.9	85.1	82.3	79.6	4.78
18	98.1	95.2	92.3	89.4	86.9	76.3	72.3	69.3	83.0	80.4	77.8	75.1	5.36
19	92.9	90.2	87.4	84.7	82.3	71.2	68.5	65.7	78.6	76.1	73.7	71.2	5.98
20	88.3	85.7	83.1	80.5	78.2	67.7	65.1	62.4	74.7	72.3	70.0	67.6	6.62
21	84.1	81.6	79.1	76.6	74.5	64.4	62.0	59.4	71.1	68.9	66.7	64.4	7.30
22	80.3	77.9	75.5	73.1	71.1	61.5	59.1	56.7	67.9	65.8	63.6	61.5	8.01
23	76.8	74.5	72.2	70.0	68.0	58.8	56.6	54.2	64.9	62.9	60.9	58.8	8.76
24	73.6	71.4	69.2	67.0	65.2	56.4	54.2	52.0	62.2	60.3	58.3	56.4	9.53
25	70.6	68.5	66.5	64.4	62.6	54.1	52.0	49.9	59.8	57.9	56.0	54.1	10.35
26	67.9	65.9	63.9	61.9	60.2	52.1	50.0	48.0	57.5	55.6	53.8	52.0	11.19
27	65.4	63.5	61.5	59.6	57.9	50.1	48.2	46.2	55.3	53.6	51.8	50.1	12.07
28	63.1	61.2	59.3	57.5	55.9	48.3	46.5	44.6	53.3	51.7	50.0	48.3	12.98
29	60.9	59.1	57.3	55.5	53.9	46.7	44.9	43.0	51.5	49.9	48.3	46.6	13.92
30	58.9	57.1	55.4	53.6	52.1	45.1	43.4	41.6	49.8	48.2	46.7	45.1	14.90
31	57.0	55.3	53.6	51.9	50.5	43.7	42.0	40.2	48.2	46.7	45.2	43.6	15.91
32	55.2	53.6	51.9	50.3	48.9	42.3	40.7	39.0	46.7	45.2	43.7	42.3	16.95
33	53.5	51.9	50.4	48.8	47.4	41.0	39.4	37.8	45.3	43.8	42,4	41.0	18.03
34	51.9	50.4	48.9	47.3	46.0	39.8	38.3	36.7	43.9	42.6	41.2	39.8	19.13
35	50.5	49.0	47.5	46.0	44.7	38.7	37.2	35.6	42.7	41.3	40.0	38.6	20.28
36	49.1	47.6	46.2	44.7	43.4	37.6	36.1	34.7	41.5	40.2	38.9	37.6	21.45
37	47.7	46.3	44.9	43.5	42.3	36.6	35.2	33.7	40.4	39.1	37.8	36.6	22.66
38	46.5	45.1	43.7	42.3	41.2	35.6	34.2	32.8	39.3	38.1	36.8	35.6	23.90
39	45.3	43.9	42.6	41.3	40.1	34.7	33.4	32.0					25.18
40	44.1	42.8	41.5	40.2	39.1	33.8	32.5	31.2					26.48
41	43.1	41.8	40.5	39.2	38.1	33.0	31.7	30.4					27.82
42	42.0	40.8	39.6	38.3	37.2	32.2	31.0	29.7					29.20

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.

BEAM SAFE LOADS.—*Continued*

BEAMS

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Maximum Bending Stress, 16,000 Pounds per Square Inch

Span in Feet	Depth and Weight of Sections													Coefficient of Deflection
	18 Inch					15 Inch								
	70 lbs.	65 lbs.	60 lbs.	55 lbs.	48 lbs.	75 lbs.	70 lbs.	65 lbs.	60 lbs.	55 lbs.	50 lbs.	45 lbs.	42 lbs.	
4	258.8	229.3	199.5			6 245.8	236.2	205.8	177.0	196.5 181.7	167.4	138.0		0.27
5	218.4	208.9	199.5			196.6	188.8	180.9	173.2	145.4	137.5	129.7		0.41
6	182.0	174.1	166.3	165.6 157.1		163.8	157.3	150.8	144.4	121.1	114.6	108.1	133.0 104.7	0.60
7	156.0	149.2	142.5	134.7	126.8 124.8	140.4	134.8	129.2	123.7	103.8	98.2	92.6	89.8	0.81
8	136.5	130.6	124.7	117.9	109.2	122.9	118.0	113.1	108.3	90.8	85.9	81.0	78.5	1.06
9	121.3	116.1	110.9	104.8	97.1	109.2	104.9	100.5	96.2	80.8	76.4	72.0	69.8	1.34
10	109.2	104.5	99.8	94.3	87.4	98.3	94.4	90.5	86.6	72.7	68.8	64.8	62.8	1.66
11	99.3	95.0	90.7	85.7	79.4	89.4	85.8	82.2	78.7	66.1	62.5	58.9	57.1	2.00
12	91.0	87.1	83.1	78.6	72.8	81.9	78.7	75.4	72.2	60.6	57.3	54.0	52.4	2.38
13	84.0	80.4	76.7	72.5	67.2	75.6	72.6	69.6	66.6	55.9	52.9	49.9	48.3	2.80
14	78.0	74.6	71.3	67.3	62.4	70.2	67.4	64.6	61.9	51.9	49.1	46.3	44.9	3.24
15	72.8	69.6	66.5	62.9	58.2	65.5	62.9	60.3	57.7	48.5	45.8	43.2	41.9	3.72
16	68.2	65.3	62.4	58.9	54.6	61.4	59.0	56.5	54.1	45.4	43.0	40.5	39.3	4.24
17	64.2	61.5	58.7	55.5	51.4	57.8	55.5	53.2	50.9	42.8	40.4	38.1	37.0	4.78
18	60.7	58.0	55.4	52.4	48.5	54.6	52.4	50.3	48.1	40.4	38.2	36.0	34.9	5.36
19	57.5	55.0	52.5	49.6	46.0	51.7	49.7	47.6	45.6	38.3	36.2	34.1	33.1	5.98
20	54.6	52.2	49.9	47.1	43.7	49.2	47.2	45.2	43.3	36.3	34.4	32.4	31.4	6.62
21	52.0	49.7	47.5	44.9	41.6	46.8	44.9	43.1	41.2	34.6	32.7	30.9	29.9	7.30
22	49.6	47.5	45.3	42.9	39.7	44.7	42.9	41.1	39.4	33.0	31.3	29.5	28.6	8.01
23	47.5	45.4	43.4	41.0	38.0	42.7	41.0	39.3	37.7	31.6	29.9	28.2	27.3	8.76
24	45.5	43.5	41.6	39.3	36.4	41.0	39.3	37.7	36.1	30.3	28.6	27.0	26.2	9.53
25	43.7	41.8	39.9	37.7	34.9	39.3	37.8	36.2	34.6	29.1	27.5	25.9	25.1	10.35
26	42.0	40.2	38.4	36.3	33.6	37.8	36.3	34.8	33.3	28.0	26.4	24.9	24.2	11.19
27	40.4	38.7	37.0	34.9	32.4	36.4	35.0	33.5	32.1	26.9	25.5	24.0	23.3	12.07
28	39.0	37.3	35.6	33.7	31.2	35.1	33.7	32.3	30.9	26.0	24.6	23.2	22.4	12.98
29	37.6	36.0	34.4	32.5	30.1	33.9	32.5	31.2	29.9	25.1	23.7	22.4	21.7	13.92
30	36.4	34.8	33.3	31.4	29.1	32.8	31.5	30.2	28.9	24.2	22.9	21.6	20.9	14.90
31	35.2	33.7	32.2	30.4	28.2	31.7	30.4	29.2	27.9	23.4	22.2	20.9	20.3	15.91
32	34.1	32.6	31.2	29.5	27.3	30.7	29.5	28.3	27.1	22.7	21.5	20.3	19.6	16.95
33	33.1	31.7	30.2	28.6	26.5									18.03
34	32.1	30.7	29.3	27.7	25.7									19.13
35	31.2	29.8	28.5	26.9	25.0									20.28
36	30.3	29.0	27.7	26.2	24.3									21.45
37	29.5	28.2	27.0	25.5	23.6									22.66
38	28.7	27.5	26.3	24.8	23.0									23.90

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.

BEAM SAFE LOADS.—*Continued*

BEAMS

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Maximum Bending Stress, 16,000 Pounds per Square Inch

Span in Feet	Depth and Weight of Sections													Coefficient of Deflection
	15 In.	12 Inch							10 Inch					
	37½ lbs.	55 lbs.	50 lbs.	45 lbs.	40 lbs.	35 lbs.	31½ lbs.	28 lbs.	40 lbs.	35 lbs.	30 lbs.	25 lbs.	22¼ lbs.	
3		197.0 190.2							149.8 112.8	120.4 104.1				0.15
4		142.7	167.8 134.8	138.2 127.0		104.6 101.5			84.6	78.1	91.0 71.6			0.27
5		114.1	107.9	101.6	110.4 95.6	81.2	84.0 76.7		67.7	62.5	57.2	62.0 52.1	50.4 48.5	0.41
6	99.6 96.1	95.1	89.9	84.7	79.7	67.6	63.8	68.2 59.1	56.4	52.1	47.7	43.4	40.4	0.60
7	82.4	81.5	77.0	72.6	68.3	58.0	54.8	50.6	48.4	44.6	40.9	37.2	34.6	0.81
8	72.1	71.3	67.4	63.5	59.8	50.7	48.0	44.3	42.3	39.0	35.8	32.6	30.3	1.06
9	64.1	63.4	59.9	56.4	53.1	45.1	42.6	39.4	37.6	34.7	31.8	28.9	26.9	1.34
10	57.7	57.1	53.9	50.8	47.8	40.6	38.4	35.5	33.9	31.2	28.6	26.0	24.2	1.66
11	52.4	51.9	49.0	46.2	43.5	36.9	34.9	32.2	30.8	28.4	26.0	23.7	22.0	2.00
12	48.1	47.6	44.9	42.3	39.8	33.8	32.0	29.5	28.2	26.0	23.9	21.7	20.2	2.38
13	44.4	43.9	41.5	39.1	36.8	31.2	29.5	27.3	26.0	24.0	22.0	20.0	18.6	2.80
14	41.2	40.8	38.5	36.3	34.2	29.0	27.4	25.3	24.2	22.3	20.4	18.6	17.3	3.24
15	38.4	38.0	36.0	33.9	31.9	27.1	25.6	23.6	22.6	20.8	19.1	17.4	16.2	3.72
16	36.0	35.7	33.7	31.7	29.9	25.4	24.0	22.2	21.2	19.5	17.9	16.3	15.1	4.24
17	33.9	33.6	31.7	29.9	28.1	23.9	22.6	20.9	19.9	18.4	16.8	15.3	14.3	4.78
18	32.0	31.7	30.0	28.2	26.6	22.5	21.3	19.7	18.8	17.4	15.9	14.5	13.5	5.36
19	30.4	30.0	28.4	26.7	25.2	21.4	20.2	18.7	17.8	16.4	15.1	13.7	12.8	5.98
20	28.8	28.5	27.0	25.4	23.9	20.3	19.2	17.7	16.9	15.6	14.3	13.0	12.1	6.62
21	27.5	27.2	25.7	24.2	22.8	19.3	18.3	16.9	16.1	14.9	13.6	12.4	11.5	7.30
22	26.2	25.9	24.5	23.1	21.7	18.4	17.4	16.1	15.4	14.2	13.0	11.8	11.0	8.01
23	25.1	24.8	23.4	22.1	20.8	17.6	16.7	15.4						8.76
24	24.0	23.8	22.5	21.2	19.9	16.9	16.0	14.8						9.53
25	23.1	22.8	21.6	20.3	19.1	16.2	15.3	14.2						10.35
26	22.2	21.9	20.7	19.5	18.4	15.6	14.8	13.6						11.19
27	21.4													12.07
28	20.6													12.98
29	19.9													13.92
30	19.2													14.90
31	18.6													15.91
32	18.0													16.95

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.

BEAM SAFE LOADS.—*Continued*

BEAMS

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Maximum Bending Stress, 16,000 Pounds per Square Inch

Span in Feet	Depth and Weight of Sections												Coefficient of Deflection
	9 Inch				8 Inch					7 Inch			
	35 lbs.	30 lbs.	25 lbs.	21 lbs.	25½ lbs.	23 lbs.	20½ lbs.	18 lbs.	17½ lbs.	20 lbs.	17½ lbs.	15 lbs.	
	131.8	102.4	73.1		86.6	71.8	57.1			64.1	49.4		
3	88.3	80.5	72.6	52.2	60.8	57.3	53.9	43.2		42.9	39.8	35.0	0.15
4	66.2	60.4	54.5	50.3	45.6	43.0	40.4	37.9	35.2	32.1	29.9	27.6	0.27
5	53.0	48.3	43.6	40.3	36.5	34.4	32.3	30.3	31.1	25.7	23.9	22.1	0.41
6	44.2	40.2	36.3	33.6	30.4	28.7	26.9	25.3	25.9	21.4	19.9	18.4	0.60
7	37.9	34.5	31.1	28.8	26.1	24.6	23.1	21.7	22.2	18.4	17.1	15.8	0.81
8	33.1	30.2	27.2	25.2	22.8	21.5	20.2	19.0	19.5	16.1	14.9	13.8	1.06
9	29.4	26.8	24.2	22.4	20.3	19.1	18.0	16.9	17.3	14.3	13.3	12.3	1.34
10	26.5	24.1	21.8	20.1	18.2	17.2	16.2	15.2	15.6	12.9	11.9	11.0	1.66
11	24.1	22.0	19.8	18.3	16.6	15.6	14.7	13.8	14.2	11.7	10.9	10.0	2.00
12	22.1	20.1	18.2	16.8	15.2	14.3	13.5	12.6	13.0	10.7	10.0	9.2	2.38
13	20.4	18.6	16.8	15.5	14.0	13.2	12.4	11.7	12.0	9.9	9.2	8.5	2.80
14	18.9	17.2	15.6	14.4	13.0	12.3	11.5	10.8	11.1	9.2	8.5	7.9	3.24
15	17.7	16.1	14.5	13.4	12.2	11.5	10.8	10.1	10.4	8.6	8.0	7.4	3.72
16	16.6	15.1	13.6	12.6	11.4	10.8	10.1	9.5	9.7	8.0	7.5	6.9	4.24
17	15.6	14.2	12.8	11.8	10.7	10.1	9.5	8.9	9.2				4.78
18	14.7	13.4	12.1	11.2	10.1	9.6	9.0	8.4	8.6				5.36
19	13.9	12.7	11.5	10.6									5.98
20	13.3	12.1	10.9	10.1									6.62

Span in Feet	Depth and Weight of Sections													Coefficient of Deflection
	6 Inch			5 Inch			4 Inch				3 Inch			
	17¼ lbs.	14¾ lbs.	12¼ lbs.	14¾ lbs.	12¼ lbs.	9¾ lbs.	10½ lbs.	9½ lbs.	8½ lbs.	7½ lbs.	7½ lbs.	6½ lbs.	5½ lbs.	
											21.7			
1	57.0			50.4	35.7		32.8	27.0	21.0		20.7	15.8	10.2	0.02
2	46.6	42.2	27.6	32.3	29.1	21.0	19.0	18.0	16.9	15.2	10.4	9.6	8.8	0.07
3	31.0	28.4	25.8	21.5	19.4	17.2	12.7	12.0	11.3	10.6	6.9	6.4	5.9	0.15
4	23.3	21.3	19.4	16.2	14.5	12.9	9.5	9.0	8.5	8.0	5.2	4.8	4.4	0.27
5	18.6	17.1	15.5	12.9	11.6	10.3	7.6	7.2	6.8	6.4	4.1	3.8	3.5	0.41
6	15.5	14.2	12.9	10.8	9.7	8.6	6.3	6.0	5.6	5.3	3.5	3.2	2.9	0.60
7	13.3	12.2	11.1	9.2	8.3	7.4	5.4	5.1	4.8	4.5	3.0	2.7	2.5	0.81
8	11.6	10.7	9.7	8.1	7.3	6.4	4.8	4.5	4.2	4.0	2.6	2.4	2.2	1.06
9	10.3	9.5	8.6	7.2	6.5	5.7	4.2	4.0	3.8	3.5				1.34
10	9.3	8.5	7.7	6.5	5.8	5.2	3.8	3.6	3.4	3.2				1.66
11	8.5	7.8	7.0	5.9	5.3	4.7								2.00
12	7.8	7.1	6.5	5.4	4.8	4.3								2.38
13	7.2	6.6	6.0											2.80
14	6.7	6.1	5.5											3.24

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.

BEAM SAFE LOADS.—*Continued*

BEAMS—ALLOWABLE UNIFORM LOAD IN POUNDS PER FOOT

Depth, Ins.	Pounds per Foot	Span in Feet																			
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	30
27	90	23340	19290	16210	13810	11910	10370	9120	8080	7200	6470	5840	5290	4820	4410	4050	3730	3450	3200	2980	2590
24	115	26270	21710	18240	15550	13400	11680	10260	9090	8110	7280	6570	5960	5430	4970	4560	4200	3890	3600	3350	2920
	110	25630	21180	17800	15170	13080	11390	10010	8870	7910	7100	6410	5810	5300	4850	4450	4100	3790	3520	3270	2850
	105	24990	20650	17360	14790	12750	11110	9760	8650	7710	6920	6250	5670	5160	4720	4340	4000	3700	3430	3190	2780
	100	21150	17480	14690	12520	10790	9400	8260	7320	6530	5860	5290	4800	4370	4000	3670	3380	3130	2900	2700	2350
	95	20520	16960	14250	12150	10470	9120	8020	7100	6340	5690	5130	4650	4240	3880	3560	3280	3040	2820	2620	2280
	90	19900	16440	13820	11770	10150	8840	7770	6880	6140	5510	4970	4510	4110	3760	3450	3180	2940	2730	2540	2210
	85	19270	15930	13380	11400	9830	8560	7530	6670	5950	5340	4820	4370	3980	3640	3350	3080	2850	2640	2460	2140
	80	18550	15330	12880	10980	9470	8250	7250	6420	5730	5140	4640	4210	3830	3610	3220	2970	2750	2550	2370	2060
	74	17330	14330	12040	10260	8840	7700	6770	6000	5350	4800	4330	3930	3580	3280	3010	2770	2560	2380	2210	1930
21	60.5	12550	10370	8720	7430	6400	5580	4900	4340	3870	3480	3140	2850	2590	2370	2180	2010	1860	1720	1600	1400
20	100	17660	14590	12260	10450	9010	7850	6900	6110	5450	4890	4420	4000	3650	3340	3070	2830	2610	2420	2250	1960
	95	17140	14160	11900	10140	8740	7620	6690	5930	5290	4750	4280	3890	3540	3240	2980	2740	2540	2350	2190	1900
	90	16610	13730	11540	9830	8480	7380	6490	5750	5130	4600	4150	3770	3430	3140	2880	2660	2460	2280	2120	1850
	85	16090	13300	11170	9520	8210	7150	6290	5570	4970	4460	4020	3650	3320	3040	2790	2570	2380	2210	2050	1790
	80	15640	12930	10860	9260	7980	6950	6110	5410	4830	4330	3910	3550	3230	2960	2720	2500	2310	2150	2000	1740
	75	13530	11180	9400	8010	6910	6020	5290	4680	4180	3750	3380	3070	2800	2560	2350	2170	2000	1860	1730	1500
	70	13010	10750	9040	7700	6640	5780	5080	4500	4020	3600	3250	2950	2690	2460	2260	2080	1920	1790	1660	1450
	65	12480	10310	8660	7380	6370	5440	4870	4320	3850	3460	3120	2830	2580	2360	2170	2000	1850	1710	1590	1390
18	90	14940	12350	10370	8840	7620	6640	5840	5170	4610	4130	3730	3390	3090	2820	2590	2390	2210	2050	1910	1660
	85	14470	11960	10050	8560	7380	6430	5650	5010	4470	4010	3620	3280	2990	2740	2510	2310	2140	1980	1850	1610
	80	14000	11570	9720	8280	7140	6220	5470	4840	4320	3880	3500	3170	2890	2650	2430	2240	2070	1920	1790	1560
	75	13530	11180	9390	8000	6900	6010	5280	4680	4180	3750	3380	3070	2800	2560	2350	3160	2000	1860	1730	1500
	70	10920	9020	7580	6460	5570	4850	4260	3780	3370	3020	2730	2480	2260	2060	1900	1750	1620	1500	1390	1210
	65	10450	8630	7260	6180	5330	4640	4080	3620	3220	2890	2610	2370	2160	1970	1810	1670	1550	1430	1330	1160
	60	9980	8250	6930	5900	5090	4430	3900	3450	3080	2760	2490	2260	2060	1890	1730	1600	1480	1370	1270	1110
	55	9430	7790	6550	5580	4810	4190	3680	3260	2910	2610	2360	2140	1950	1780	1640	1510	1400	1290	1200	1050
	48	8740	7220	6070	5170	4460	4880	3410	3020	2700	2420	2180	1980	1800	1650	1520	1400	1290	1200	1110	970

BEAM SAFE LOADS.—*Continued*

BEAMS—ALLOWABLE UNIFORM LOAD IN POUNDS PER FOOT

Depth, Ins.	Pounds per Foot	Span in Feet																				
		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
15	75	27310	20060	15360	12140	9830	8120	6830	5820	5020	4370	3840	3400	3030	2720	2460	2230	2030	1860	1710	1570	1450
	70	26220	19260	14750	11650	9440	7800	6550	5590	4820	4200	3690	3270	2910	2610	2360	2140	1950	1780	1640	1510	1400
	65	25130	18460	14140	11170	9050	7480	6280	5350	4620	4020	3530	3130	2790	2510	2260	2050	1870	1710	1570	1450	1340
	60	24060	17680	13530	10690	8660	7160	6010	5130	4420	3850	3380	3000	2670	2400	2170	1960	1790	1640	1500	1390	1280
	55	20190	14830	11360	8970	7370	6010	5050	4300	3710	3230	2840	2520	2240	2010	1820	1650	1500	1370	1260	1160	1080
	50	19100	14030	10740	8490	6880	5680	4780	4070	3510	3060	2690	2380	2120	1910	1720	1560	1420	1300	1190	1100	1020
	45	18010	13230	10130	8000	6480	5360	4500	3840	3310	2880	2530	2240	2000	1800	1620	1470	1340	1230	1130	1040	960
	42	17450	12820	9820	7760	6280	5190	4360	3720	3210	2790	2450	2170	1940	1740	1570	1430	1300	1190	1090	1010	930
	37.5	16020	11770	9010	7120	5770	4770	4010	3410	2940	2560	2250	2000	1780	1600	1440	1310	1190	1090	1000	920	850
12	55	15850	11650	8920	7050	5710	4720	3960	3380	2910	2540	2230	1980	1760	1580	1430	1290	1180	1080	990	910	840
	50	14980	11010	8430	6660	5390	4460	3750	3190	2750	2400	2110	1870	1660	1490	1350	1220	1110	1020	940	860	800
	45	14110	10370	7940	6270	5080	4200	3530	3010	2590	2260	1980	1760	1570	1410	1270	1150	1050	960	880	810	750
	40	13280	9760	7470	5900	4780	3950	3320	2830	2440	2130	1870	1650	1480	1320	1200	1080	990	900	830	770	710
	35	11270	8280	6340	5010	4060	3350	2820	2400	2070	1800	1580	1400	1250	1120	1020	920	840	770	700	650	600
	31.5	10660	7830	6000	4740	3840	3170	2660	2270	1960	1710	1500	1330	1180	1060	960	870	790	730	670	610	570
	28	9850	7240	5540	4380	3550	2930	2460	2100	1810	1580	1390	1230	1090	980	890	800	730	670	620	570	520
10	40	9400	6910	5290	4180	3390	2800	2350	2000	1730	1500	1320	1170	1040	940	850	770	700				
	35	8680	6380	4880	3860	3120	2580	2170	1850	1590	1390	1220	1080	960	870	780	710	650				
	30	7950	5840	4470	3530	2860	2370	1990	1690	1460	1270	1120	990	880	790	720	650	590				
	25	7240	5320	4070	3220	2610	2150	1810	1540	1330	1160	1020	900	800	720	650	590	540				
	22.25	6730	4950	3790	2990	2420	2000	1680	1430	1240	1080	950	840	750	670	610	550	500				
9	35	7360	5410	4140	3270	2650	2190	1840	1570	1350	1180	1040	920	820	730	660						
	30	6710	4930	3770	2980	2420	2000	1680	1430	1230	1070	940	840	750	670	600						
	25	6050	4450	3410	2690	2180	1800	1510	1290	1110	970	850	750	670	600	540						
	21	5590	4110	3150	2490	2010	1660	1400	1190	1030	900	790	700	620	560	500						

Loads below dotted horizontal lines will produce excessive deflection.

BEAM SAFE LOADS.—*Continued*

BEAMS—ALLOWABLE UNIFORM LOAD IN POUNDS PER FOOT

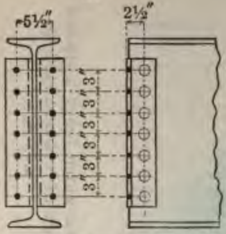
Depth, Ins.	Pounds per Foot	Span in Feet 2	2½	3	3½	4	4½	5	5½	6	6½	7	8	9	10	11	12	13	14	15	16	17	18
8	25.5	43280	29200	20280	14900	11410	9010	7300	6030	5070	4320	3720	2850	2250	1830	1510	1270	1080	930	810	710	630	560
	23.	35920	27520	19110	14040	10750	8490	6880	5690	4780	4070	3510	2690	2120	1720	1420	1190	1020	880	760	670	600	530
	20.5	28560	22840	17950	13190	10100	7980	6460	5340	4490	3820	3300	2520	1990	1620	1340	1120	960	820	720	630	560	500
	18.	21600	17280	14400	12340	9480	7490	6070	5010	4210	3590	3100	2370	1870	1520	1250	1050	900	770	670	590	530	470
	17.5	17600	14080	11730	10060	8800	7690	6230	5150	4320	3680	3180	2430	1920	1560	1290	1080	920	790	690	610	540	480
7	20.	32060	20570	14280	10490	8040	6350	5140	4250	3570	3040	2620	2010	1590	1290	1060	890	760	660	570	500		
	17.5	24710	19100	13270	9750	7460	5900	4780	3950	3320	2830	2440	1870	1470	1190	990	830	710	610	530	470		
	15.	17500	14000	11700	9010	6900	5450	4420	3650	3070	2610	2250	1730	1360	1100	910	770	650	560	490	430		
6	17.25	23280	14900	10350	7600	5820	4600	3720	3080	2590	2200	1900	1450	1150	930	770	650	550	480				
	14.75	21120	13650	9470	6960	5330	4210	3410	2820	2370	2020	1740	1330	1050	850	700	590	500	440				
	12.25	13800	11040	8610	6320	4840	3830	3100	2560	2150	1830	1580	1210	960	780	640	540	460	400				
5	14.75	16160	10340	7180	5280	4040	3190	2590	2140	1800	1530	1320	1010	800	650	530	450						
	12.25	14530	9300	6460	4740	3630	2870	2320	1920	1610	1380	1190	910	720	580	480	400						
	9.75	10500	8250	5730	4210	3220	2550	2060	1710	1430	1220	1050	810	640	520	430	360						
4	10.5	9520	6090	4230	3110	2380	1880	1520	1260	1060	900	780	590	470	380								
	9.5	9000	5760	4000	2940	2250	1780	1440	1190	1000	850	730	560	440	360								
	8.5	8470	5420	3770	2770	2120	1670	1360	1120	940	800	690	530	420	340								
	7.5	7600	5090	3530	2600	1990	1570	1270	1050	880	750	650	500	390	320								
3	7.5	5180	3310	2300	1690	1290	1020	830	680	580	490	420											
	6.5	4780	3060	2130	1560	1200	940	770	630	530	450	390											
	5.5	4410	2820	1960	1440	1100	870	710	580	490	420	360											

Loads within heavy horizontal lines are maximum loads for web shear

Loads below dotted horizontal lines will produce excessive deflection

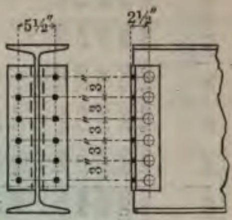
BEAM CONNECTIONS

27"



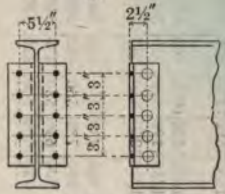
2 Ls 4"x 4"x ½"x 1′-8½"
Weight 46 lbs.

24"



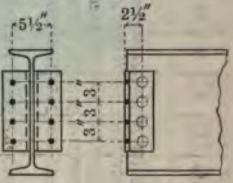
2 Ls 4"x 4"x ½"x 1′-5½"
Weight 39 lbs.

21"



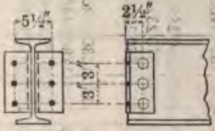
2 Ls 4"x 4"x ½"x 1′-2½"
Weight 33 lbs.

20," 18," 15"



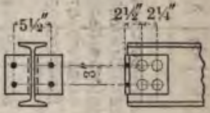
2 Ls 4"x 4"x 7/16"x 0′-11½"
Weight 23 lbs.

12"



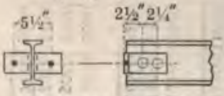
2 Ls 4"x 4"x 7/16"x 0′-8½"
Weight 17 lbs.

10," 9," 8"



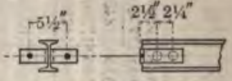
2 Ls 6"x 4"x ⅜"x 0′-5½"
Weight 13 lbs.

7," 6," 5"



2 Ls 6"x 4"x ⅜"x 0′-3"
Weight 7 lbs.

4," 3"



2 Ls 6"x 4"x ⅜"x 0-2"
Weight 5 lbs.

Rivets and bolts ¾" diameter.

Weights given are for ¾-inch shop rivets and angle connections; about 20 per cent. sho be added for field rivets or bolts.

BEAM CONNECTIONS.—*Continued*

LIMITING VALUES OF BEAM CONNECTIONS

I Beams		Value of Web Connection	Values of Outstanding Legs of Connection Angles					
			Field Rivets			Field Bolts		
Depth, Inches	Weight Pounds per Foot	Shop Rivets in Enclosed Bearing, Pounds	¾" Rivets or Turned Bolts, Single Shear, Pounds	Minimum Allowable Span in Feet, Uniform Load	t, In.	¾" Rough Bolts, Single Shear, Pounds	Minimum Allowable Span in Feet, Uniform Load	t, In.
27	90	82530	61900	18.9	⅝	49500	23.6	⅝
24	80	67500	53000	17.5	⅝	42400	21.9	⅝
	74	64260	53000	16.4	⅝	42400	20.4	⅝
21	60½	48150	44200	14.2	⅝	35300	17.8	⅝
20	65	45000	35300	17.6	⅝	28300	22.1	⅝
18	55	41400	35300	13.3	⅝	28300	16.7	⅝
	48	34200	35300	12.8	9/16	28300	15.4	⅝
15	42	36900	35300	8.9	⅝	28300	11.1	⅝
	37½	29880	35300	9.7	½	28300	10.2	9/16
12	31½	23600	26500	8.1	9/16	21200	9.0	⅝
	28	19170	26500	9.2	7/16	21200	9.2	½
10	25	27900	17700	7.4	⅝	14100	9.2	⅝
	22¼	22680	17700	6.8	⅝	14100	8.6	⅝
9	21	26100	17700	5.7	⅝	14100	7.1	⅝
8	18	24300	17700	4.3	⅝	14100	5.4	⅝
	17½	19800	17700	4.4	⅝	14100	5.5	⅝
7	15	11300	8800	6.2	⅝	7100	7.8	⅝
6	12¼	10400	8800	4.4	⅝	7100	5.5	⅝
5	9¾	9500	8800	2.9	⅝	7100	3.6	⅝
4	7½	8600	8800	2.2	9/16	7100	2.7	⅝
3	5½	7700	8800	1.3	½	7100	1.4	⅝

ALLOWABLE UNIT STRESS IN POUNDS PER SQUARE INCH

Single Shear	Rivets..................Shop 12000 Rivets and Turned Bolts..Field 10000 Rough Bolts.............Field 8000	Bearing	Rivets—enclosed.........Shop 30000 Rivets—one side..........Shop 24000 Rivets and Turned Bolts..Field 20000 Rough Bolts.............Field 16000

t = Web thickness, in bearing, to develop max. allowable reactions, when beams frame opposite.

Connections are figured for bearing and shear (no moment considered).

The above values agree with tests made on beams under ordinary conditions of use.

Where web is enclosed between connection angles (enclosed bearing), values are greater because of the increased efficiency due to friction and grip.

Special connections shall be used when any of the limiting conditions given above are exceeded—such as end reaction from loaded beam being greater than value of connection; shorter span with beam fully loaded; or a less thickness of web when maximum allowable reactions are used.

RIVETED BEAM GIRDERS AND RIVETED PLATE GIRDERS

Where single rolled beams are insufficient to carry the loads, the required capacity may be secured by fabrication in various methods.

Two beams can be used, connected together by bolts and separators. The total strength of these is twice that of the single beam of the same depth and weight. Care should be taken, however, to see that the loads are applied on them equally and where it is necessary for the beams to act as a unit, the separators should be of plates and angles and not of cast iron. If the loading is not uniform on the two sections, their strength must be computed separately.

The use of single beam girders with plates top and bottom to sustain a given load is often more economical in material than the use of two beams connected by bolts and separators.

Box girders formed of two beams with flange plates riveted thereto are often used for supporting interior walls in buildings. They are not, however, as economical in material as single beams with flange plates or plate girders. Their interior surfaces do not admit of repainting and they should, therefore, not be used in exposed places.

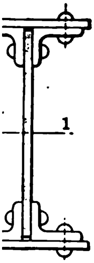
The most economical section to sustain heavy loads is the single web plate girder and it is sufficient for all ordinary purposes. When not so, two single web plate girders may be used, together with tie plates extending clear across the angles, or box girders may be made of four flange angles, two web plates and top and bottom flange plates. In case there is unequal distribution of the load, the two girders or half girders must be figured as separate units.

In the design of beam or plate girders, care must be taken to see that the web is of sufficient thickness to resist buckling stress and, therefore, attention is called to the construction specifications and to the remarks made on pages 650 and 651, as to shearing stresses in general.

The tables which follow give elements of riveted plate girders of various depths from which it is possible to select economical sections for almost any ordinary condition of loading.

In accordance with the construction specifications, these girder tables are based upon the section modulus of the gross area of the section, with bending stress allowed at 16,000 pounds per square inch.

RIVETED PLATE GIRDERS



To obtain a girder suitable to carry any specified loading, determine the maximum end reaction in pounds and the maximum bending moment in inch-pounds.

Select from the table a girder having the desired depth, a thickness of web as determined by the maximum end reaction and a suitable section modulus as determined by dividing the bending moment by the permissible stress per square inch.

For limiting conditions see explanatory notes, page 662, and specifications, page 548.

Weights given do not include stiffeners, rivet heads, or other details.

Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
24 x 5/16	4 x 3 x ⅜		59.5		50.6
	4 x 3 x ½		69.9		50.6
	5 x 3½ x ½		79.9		50.6
	5 x 3½ x ⅝		92.7		50.6
	5 x 3½ x ½	12 x ½	79.9	40.8	50.6
	5 x 3½ x ½	12 x ⅝	79.9	51.0	50.6
	5 x 3½ x ⅝	12 x ⅝	92.7	51.0	50.6
24 x ⅜	4 x 3 x ⅜		64.6		60.8
	5 x 3½ x ⅜		72.2		60.8
	4 x 3 x ½		75.0		60.8
	4 x 3 x ⅝		85.0		60.8
	5 x 3½ x ½		85.0		60.8
	5 x 3½ x ⅝		97.8		60.8
	5 x 3½ x ⅜	12 x ⅜	72.2	30.6	60.8
	5 x 3½ x ⅜	12 x ½	72.2	40.8	60.8
	5 x 3½ x ½	12 x ½	85.0	40.8	60.8
	5 x 3½ x ½	12 x ⅝	85.0	51.0	60.8
	5 x 3½ x ⅝	12 x ⅝	97.8	51.0	60.8
26 x 5/16	4 x 3 x ⅜		61.6		56.3
	5 x 3½ x ⅜		69.2		56.3
	4 x 3 x ½		72.0		56.3
	6 x 4 x ⅜		76.8		56.3
	5 x 3½ x ½		82.0		56.3
	6 x 4 x ½		92.4		56.3
	5 x 3½ x ⅝		94.8		56.3
	5 x 3½ x ⅜	12 x ⅜	69.2	30.6	56.3
	6 x 4 x ⅝		107.6		56.3
	5 x 3½ x ⅜	12 x ½	69.2	40.8	56.3
	6 x 4 x ⅜	14 x ⅜	76.8	35.7	56.3
	5 x 3½ x ½	12 x ½	82.0	40.8	56.3
	6 x 4 x ⅜	14 x ½	76.8	47.6	56.3
	5 x 3½ x ½	12 x ⅝	82.0	51.0	56.3

Riveted Plate Girders.—*Continued*

Section Modulus, Axis 1-1, Inches³	Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
	Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
428.4	26 x 5/16	6 x 4 x ½	14 x ½	92.4	47.6	56.3
447.9		5 x 3½ x ⅝	12 x ⅝	94.8	51.0	56.3
472.7		6 x 4 x ½	14 x ⅝	92.4	59.5	56.3
519.5		6 x 4 x ⅝	14 x ⅝	107.6	59.5	56.3
563.4		6 x 4 x ⅝	14 x ¾	107.6	71.4	56.3
158.5	26 x ⅜	4 x 3 x ⅜		67.2		67.5
183.8		5 x 3½ x ⅜		74.8		67.5
193.5		4 x 3 x ½		77.6		67.5
208.1		6 x 4 x ⅜		82.4		67.5
226.5		4 x 3 x ⅝		87.6		67.5
226.6		5 x 3½ x ½		87.6		67.5
258.9		6 x 4 x ½		98.0		67.5
267.6		5 x 3½ x ⅝		100.4		67.5
298.0		5 x 3½ x ⅜	12 x ⅜	74.8	30.6	67.5
307.9		6 x 4 x ⅝		113.2		67.5
336.2		5 x 3½ x ⅜	12 x ½	74.8	40.8	67.5
341.5		6 x 4 x ⅜	14 x ⅜	82.4	35.7	67.5
354.4		6 x 4 x ¾		127.6		67.5
377.4		5 x 3½ x ½	12 x ½	87.6	40.8	67.5
386.1		6 x 4 x ⅜	14 x ½	82.4	47.6	67.5
415.2		5 x 3½ x ½	12 x ⅝	87.6	51.0	67.5
435.1		6 x 4 x ½	14 x ½	98.0	47.6	67.5
454.5		5 x 3½ x ⅝	12 x ⅝	100.4	51.0	67.5
479.3		6 x 4 x ½	14 x ⅝	98.0	59.5	67.5
526.1		6 x 4 x ⅝	14 x ⅝	113.2	59.5	67.5
569.9		6 x 4 x ⅝	14 x ¾	113.2	71.4	67.5
613.9		6 x 4 x ¾	14 x ¾	127.6	71.4	67.5
200.4	26 x 7/16	4 x 3 x ½		83.1		78.8
233.4		4 x 3 x ⅝		93.1		78.8
233.5		5 x 3½ x ½		93.1		78.8
265.8		6 x 4 x ½		103.5		78.8
274.5		5 x 3½ x ⅝		105.9		78.8
314.8		6 x 4 x ⅝		118.7		78.8
361.3		6 x 4 x ¾		133.1		78.8
384.0		5 x 3½ x ½	12 x ½	93.1	40.8	78.8
421.8		5 x 3½ x ½	12 x ⅝	93.1	51.0	78.8
441.7		6 x 4 x ½	14 x ½	103.5	47.6	78.8
461.1		5 x 3½ x ⅝	12 x ⅝	105.9	51.0	78.8
485.9		6 x 4 x ½	14 x ⅝	103.5	59.5	78.8
532.7		6 x 4 x ⅝	14 x ⅝	118.7	59.5	78.8
576.5		6 x 4 x ⅝	14 x ¾	118.7	71.4	78.8
620.5		6 x 4 x ¾	14 x ¾	133.1	71.4	78.8

RIVETED PLATE GIRDERS.—*Continued*

Section Modulus, Axis 1–1, Inches³	Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
	Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
185.6	27 x 5/16	5 x 3½ x ⅜		70.3		56.3
211.0		6 x 4 x ⅜		77.9		56.3
230.3		5 x 3½ x ½		83.1		56.3
264.1		6 x 4 x ½		93.5		56.3
273.2		5 x 3½ x ⅝		95.9		56.3
304.5		5 x 3½ x ⅜	12 x ⅜	70.3	30.6	56.3
315.3		6 x 4 x ⅝		108.7		56.3
344.2		5 x 3½ x ⅜	12 x ½	70.3	40.8	56.3
349.8		6 x 4 x ⅜	14 x ⅜	77.9	35.7	56.3
387.3		5 x 3½ x ½	12 x ½	83.1	40.8	56.3
396.2		6 x 4 x ⅜	14 x ½	77.9	47.6	56.3
426.7		5 x 3½ x ½	12 x ⅝	83.1	51.0	56.3
447.4		6 x 4 x ½	14 x ½	93.5	47.6	56.3
467.7		5 x 3½ x ⅝	12 x ⅝	95.9	51.0	56.3
493.4		6 x 4 x ½	14 x ⅝	93.5	59.5	56.3
542.4		6 x 4 x ⅝	14 x ⅝	108.7	59.5	56.3
588.0		6 x 4 x ⅝	14 x ¾	108.7	71.4	56.3
193.1	27 x ⅜	5 x 3½ x ⅜		76.0		67.5
218.5		6 x 4 x ⅜		83.6		67.5
237.8		5 x 3½ x ½		88.8		67.5
271.5		6 x 4 x ½		99.2		67.5
280.6		5 x 3½ x ⅝		101.6		67.5
311.7		5 x 3½ x ⅜	12 x ⅜	76.0	30.6	67.5
322.7		6 x 4 x ⅝		114.4		67.5
351.4		5 x 3½ x ⅜	12 x ½	76.0	40.8	67.5
357.1		6 x 4 x ⅜	14 x ⅜	83.6	35.7	67.5
371.4		6 x 4 x ¾		128.8		67.5
394.5		5 x 3½ x ½	12 x ½	88.8	40.8	67.5
403.4		6 x 4 x ⅜	14 x ½	83.6	47.6	67.5
417.9		6 x 4 x ⅞		143.2		67.5
433.8		5 x 3½ x ½	12 x ⅝	88.8	51.0	67.5
454.6		6 x 4 x ½	14 x ½	99.2	47.6	67.5
474.8		5 x 3½ x ⅝	12 x ⅝	101.6	51.0	67.5
500.5		6 x 4 x ½	14 x ⅝	99.2	59.5	67.5
549.5		6 x 4 x ⅝	14 x ⅝	114.4	59.5	67.5
595.1		6 x 4 x ⅝	14 x ¾	114.4	71.4	67.5
641.2		6 x 4 x ¾	14 x ¾	128.8	71.4	67.5
245.2	27 x 7/16	5 x 3½ x ½		94.6		78.8
279.0		6 x 4 x ½		105.0		78.8
288.1		5 x 3½ x ⅝		107.4		78.8
330.2		6 x 4 x ⅝		120.2		78.8

RIVETED PLATE GIRDERS.—*Continued*

Section Modulus, Axis 1–1, Inches³	Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
	Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
378.8	27 x 7/16	6 x 4 x ¾		134.6		78.8
401.7		5 x 3½ x ½	12 x ½	94.6	40.8	78.8
425.3		6 x 4 x ⅞		149.0		78.8
440.9		5 x 3½ x ½	12 x ⅝	94.6	51.0	78.8
461.8		6 x 4 x ½	14 x ½	105.0	47.6	78.8
482.0		5 x 3½ x ⅝	12 x ⅝	107.4	51.0	78.8
507.7		6 x 4 x ½	14 x ⅝	105.0	59.5	78.8
556.6		6 x 4 x ⅝	14 x ⅝	120.2	59.5	78.8
602.4		6 x 4 x ⅝	14 x ¾	120.2	71.4	78.8
648.2		6 x 4 x ¾	14 x ¾	134.6	71.4	78.8
194.5	28 x 5/16	5 x 3½ x ⅜		71.4		56.3
221.0		6 x 4 x ⅜		79.0		56.3
241.1		5 x 3½ x ½		84.2		56.3
276.3		6 x 4 x ½		94.6		56.3
285.8		5 x 3½ x ⅝		97.0		56.3
317.8		5 x 3½ x ⅜	12 x ⅜	71.4	30.6	56.3
329.7		6 x 4 x ⅝		109.8		56.3
359.0		5 x 3½ x ⅜	12 x ½	71.4	40.8	56.3
365.0		6 x 4 x ⅜	14 x ⅜	79.0	35.7	56.3
404.0		5 x 3½ x ½	12 x ½	84.2	40.8	56.3
413.1		6 x 4 x ⅜	14 x ½	79.0	47.6	56.3
444.8		5 x 3½ x ½	12 x ⅝	84.2	51.0	56.3
466.5		6 x 4 x ½	14 x ½	94.6	47.6	56.3
487.6		5 x 3½ x ⅝	12 x ⅝	97.0	51.0	56.3
514.2		6 x 4 x ½	14 x ⅝	94.6	59.5	56.3
565.4		6 x 4 x ⅝	14 x ⅝	109.8	59.5	56.3
612.7		6 x 4 x ⅝	14 x ¾	109.8	71.4	56.3
202.5	28 x ⅜	5 x 3½ x ⅜		77.3		67.5
229.0		6 x 4 x ⅜		84.9		67.5
249.1		5 x 3½ x ½		90.1		67.5
284.3		6 x 4 x ½		100.5		67.5
293.8		5 x 3½ x ⅝		102.9		67.5
325.6		5 x 3½ x ⅜	12 x ⅜	77.3	30.6	67.5
337.7		6 x 4 x ⅝		115.7		67.5
366.7		5 x 3½ x ⅜	12 x ½	77.3	40.8	67.5
372.8		6 x 4 x ⅜	14 x ⅜	84.9	35.7	67.5
388.5		6 x 4 x ¾		130.1		67.5
411.7		5 x 3½ x ½	12 x ½	90.1	40.8	67.5
420.8		6 x 4 x ⅜	14 x ½	84.9	47.6	67.5
437.0		6 x 4 x ⅞		144.5		67.5
452.5		5 x 3½ x ½	12 x ⅝	90.1	51.0	67.5

RIVETED PLATE GIRDERS.—*Continued*

Section Modulus, Axis 1-1, Inches^3	Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
	Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
474.3	28 x ⅜	6 x 4 x ½	14 x ½	100.5	46.6	67.5
495.3		5 x 3½ x ⅝	12 x ⅝	102.9	51.0	67.5
521.9		6 x 4 x ½	14 x ⅝	100.5	59.5	67.5
573.1		6 x 4 x ⅝	14 x ⅝	115.7	59.5	67.5
620.4		6 x 4 x ⅝	14 x ¾	115.7	71.4	67.5
668.6		6 x 4 x ¾	14 x ¾	130.1	71.4	67.5
257.1	28 x 7/16	5 x 3½ x ½		96.1		78.8
292.4		6 x 4 x ½		106.5		78.8
301.8		5 x 3½ x ⅝		108.9		78.8
345.8		6 x 4 x ⅝		121.7		78.8
396.5		6 x 4 x ¾		136.1		78.8
419.5		5 x 3½ x ½	12 x ½	96.1	40.8	78.8
445.1		6 x 4 x ⅞		150.5		78.8
460.2		5 x 3½ x ½	12 x ⅝	96.1	51.0	78.8
482.0		6 x 4 x ½	14 x ½	106.5	47.6	78.8
503.0		5 x 3½ x ⅝	12 x ⅝	108.9	51.0	78.8
529.6		6 x 4 x ½	14 x ⅝	106.5	59.5	78.8
580.8		6 x 4 x ⅝	14 x ⅝	121.7	59.5	78.8
628.0		6 x 4 x ⅝	14 x ¾	121.7	71.4	78.8
676.2		6 x 4 x ¾	14 x ¾	136.1	71.4	78.8
221.8	30 x ⅜	5 x 3½ x ⅜		79.9		74.3
250.5		6 x 4 x ⅜		87.5		74.3
272.1		5 x 3½ x ½		92.7		74.3
310.3		6 x 4 x ½		103.1		74.3
320.5		5 x 3½ x ⅝		105.5		74.3
353.8		5 x 3½ x ⅜	12 x ⅜	79.9	30.6	74.3
366.2		5 x 3½ x ¾		117.5		74.3
368.1		6 x 4 x ⅝		118.3		74.3
397.8		5 x 3½ x ⅜	12 x ½	79.9	40.8	74.3
404.7		6 x 4 x ⅜	14 x ⅜	87.5	35.7	74.3
423.1		6 x 4 x ¾		132.7		74.3
446.6		5 x 3½ x ½	12 x ½	92.7	40.8	74.3
456.1		6 x 4 x ⅜	14 x ½	87.5	47.6	74.3
475.8		6 x 4 x ⅞		147.1		74.3
490.3		5 x 3½ x ½	12 x ⅝	92.7	51.0	74.3
514.0		6 x 4 x ½	14 x ½	103.1	47.6	74.3
536.7		5 x 3½ x ⅝	12 x ⅝	105.5	51.0	74.3
565.1		6 x 4 x ½	14 x ⅝	103.1	59.5	74.3
620.6		6 x 4 x ⅝	14 x ⅝	118.3	59.5	74.3
671.3		6 x 4 x ⅝	14 x ¾	118.3	71.4	74.3
723.8		6 x 4 x ¾	14 x ¾	132.7	71.4	74.3

RIVETED PLATE GIRDERS.—*Continued*

Section Modulus, Axis 1-1, Inches³	Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousand of Pounds
	Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
281.4	30 x 7/16	5 x 3½ x ½		99.0		86.6
319.5		6 x 4 x ½		109.4		86.6
329.7		5 x 3½ x ⅝		111.8		86.6
375.5		5 x 3½ x ¾		123.8		86.6
377.3		6 x 4 x ⅝		124.6		86.6
432.3		6 x 4 x ¾		139.0		86.6
455.5		5 x 3½ x ½	12 x ½	99.0	40.8	86.6
485.0		6 x 4 x ⅞		153.4		86.6
499.2		5 x 3½ x ½	12 x ⅝	99.0	51.0	86.6
523.0		6 x 4 x ½	14 x ½	109.4	47.6	86.6
545.6		5 x 3½ x ⅝	12 x ⅝	111.8	51.0	86.6
574.0		6 x 4 x ½	14 x ⅝	109.4	59.5	86.6
629.5		6 x 4 x ⅝	14 x ⅝	124.6	59.5	86.6
680.1		6 x 4 x ⅝	14 x ¾	124.6	71.4	86.6
732.6		6 x 4 x ¾	14 x ¾	139.0	71.4	86.6
290.6	30 x ½	5 x 3½ x ½		105.4		99.0
328.8		6 x 4 x ½		115.8		99.0
338.9		5 x 3½ x ⅝		118.2		99.0
384.7		5 x 3½ x ¾		130.2		99.0
386.5		6 x 4 x ⅝		131.0		99.0
441.5		6 x 4 x ¾		145.4		99.0
464.4		5 x 3½ x ½	12 x ½	105.4	40.8	99.0
494.2		6 x 4 x ⅞		159.8		99.0
508.0		5 x 3½ x ½	12 x ⅝	105.4	51.0	99.0
531.9		6 x 4 x ½	14 x ½	115.8	47.6	99.0
554.5		5 x 3½ x ⅝	12 x ⅝	118.2	51.0	99.0
582.8		6 x 4 x ½	14 x ⅝	115.8	59.5	99.0
638.3		6 x 4 x ⅝	14 x ⅝	131.0	59.5	99.0
688.9		6 x 4 x ⅝	14 x ¾	131.0	71.4	99.0
741.3		6 x 4 x ¾	14 x ¾	145.4	71.4	99.0
251.7	33 x ⅜	5 x 3½ x ⅜		83.7		81.0
283.7		6 x 4 x ⅜		91.3		81.0
307.7		5 x 3½ x ½		96.5		81.0
308.4		6 x 6 x ⅜		101.7		121.5
350.3		6 x 4 x ½		106.9		81.0
361.5		5 x 3½ x ⅝		109.3		81.0
383.6		6 x 6 x ½		120.5		121.5
396.9		5 x 3½ x ⅜	12 x ⅜	83.7	30.6	81.0
412.5		5 x 3½ x ¾		121.3		81.0
414.7		6 x 4 x ⅝		122.1		81.0
445.5		5 x 3½ x ⅜	12 x ½	83.7	40.8	81.0
453.4		6 x 4 x ⅜	14 x ⅜	91.3	35.7	81.0

RIVETED PLATE GIRDERS.—*Continued*

Section Modulus, Axis 1-1, Inches^3	Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
	Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
455.9	33 x ⅜	6 x 6 x ⅝		138.9		121.5
476.1		6 x 4 x ¾		136.5		81.0
477.6		6 x 6 x ⅜	14 x ⅜	101.7	35.7	121.5
499.8		5 x 3½ x ½	12 x ½	96.5	40.8	81.0
510.0		6 x 4 x ⅜	14 x ½	91.3	47.6	81.0
525.4		6 x 6 x ¾		156.9		121.5
534.1		6 x 6 x ⅜	14 x ½	101.7	47.6	121.5
548.0		5 x 3½ x ½	12 x ⅝	96.5	51.0	81.0
574.7		6 x 4 x ½	14 x ½	106.9	47.6	81.0
590.6		6 x 6 x ⅜	14 x ⅝	101.7	59.5	121.5
592.6		6 x 6 x ⅞		174.5		121.5
599.9		5 x 3½ x ⅝	12 x ⅝	109.3	51.0	81.0
607.1		6 x 6 x ½	14 x ½	120.5	47.6	121.5
630.9		6 x 4 x ½	14 x ⅝	106.9	59.5	81.0
663.1		6 x 6 x ½	14 x ⅝	120.5	59.5	121.5
693.0		6 x 4 x ⅝	14 x ⅝	122.1	59.5	81.0
719.2		6 x 6 x ½	14 x ¾	120.5	71.4	121.5
732.7		6 x 6 x ⅝	14 x ⅝	138.9	59.5	121.5
748.9		6 x 4 x ⅝	14 x ¾	122.1	71.4	81.0
788.3		6 x 6 x ⅝	14 x ¾	138.9	71.4	121.5
807.6		6 x 4 x ¾	14 x ¾	136.5	71.4	81.0
854.9		6 x 6 x ¾	14 x ¾	156.9	71.4	121.5
318.9	33 x 7/16	5 x 3½ x ½		103.5		94.5
361.5		6 x 4 x ½		113.9		94.5
372.7		5 x 3½ x ⅝		116.3		94.5
394.8		6 x 6 x ½		127.5		141.8
423.7		5 x 3½ x ¾		128.3		94.5
425.8		6 x 4 x ⅝		129.1		94.5
467.0		6 x 6 x ⅝		145.9		141.8
487.2		6 x 4 x ¾		143.5		94.5
510.7		5 x 3½ x ½	12 x ½	103.5	40.8	94.5
536.6		6 x 6 x ¾		163.9		141.8
558.8		5 x 3½ x ½	12 x ⅝	103.5	51.0	94.5
585.6		6 x 4 x ½	14 x ½	113.9	47.6	94.5
603.8		6 x 6 x ⅞		181.5		141.8
610.6		5 x 3½ x ⅝	12 x ⅝	116.3	51.0	94.5
617.9		6 x 6 x ½	14 x ½	127.5	47.6	141.8
641.7		6 x 4 x ½	14 x ⅝	113.9	59.5	94.5
673.9		6 x 6 x ½	14 x ⅝	127.5	59.5	141.8
703.8		6 x 4 x ⅝	14 x ⅝	129.1	59.5	94.5

RIVETED PLATE GIRDERS.—*Continued*

Section Modulus, Axis 1–1, Inches^3	Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
	Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
729.9	33 x 7/16	6 x 6 x ½	14 x ¾	.127.5	71.4	141.8
743.5		6 x 6 x ⅝	14 x ⅝	145.9	59.5	141.8
759.6		6 x 4 x ⅝	14 x ¾	129.1	71.4	94.5
799.0		6 x 6 x ⅝	14 x ¾	145.9	71.4	141.8
818.3		6 x 4 x ¾	14 x ¾	143.5	71.4	94.5
865.6		6 x 6 x ¾	14 x ¾	163.9	71.4	141.8
330.0	33 x ½	5 x 3½ x ½		110.5		108.0
372.6		6 x 4 x ½		120.9		108.0
383.9		5 x 3½ x ⅝		123.3		108.0
406.0		6 x 6 x ½		134.5		162.0
434.9		5 x 3½ x ¾		135.3		108.0
437.0		6 x 4 x ⅝		136.1		108.0
478.2		6 x 6 x ⅝		152.9		162.0
498.4		6 x 4 x ¾		150.5		108.0
521.5		5 x 3½ x ½	12 x ½	110.5	40.8	108.0
547.8		6 x 6 x ¾		170.9		162.0
569.5		5 x 3½ x ½	12 x ⅝	110.5	51.0	108.0
596.4		6 x 4 x ½	14 x ½	120.9	47.6	108.0
615.0		6 x 6 x ⅞		188.5		162.0
621.4		5 x 3½ x ⅝	12 x ⅝	123.3	51.0	108.0
628.8		6 x 6 x ½	14 x ½	134.5	47.6	162.0
652.5		6 x 4 x ½	14 x ⅝	120.9	59.5	108.0
684.6		6 x 6 x ½	14 x ⅝	134.5	59.5	162.0
714.5		6 x 4 x ⅝	14 x ⅝	136.1	59.5	108.0
740.6		6 x 6 x ½	14 x ¾	134.5	71.4	162.0
754.3		6 x 6 x ⅝	14 x ⅝	152.9	59.5	162.0
770.3		6 x 4 x ⅝	14 x ¾	136.1	71.4	108.0
809.7		6 x 6 x ⅝	14 x ¾	152.9	71.4	162.0
829.0		6 x 4 x ¾	14 x ¾	150.5	71.4	108.0
876.3		6 x 6 x ¾	14 x ¾	170.9	71.4	162.0
318.0	36 x ⅜	6 x 4 x ⅜		95.1		87.8
344.4		5 x 3½ x ½		100.3		87.8
346.9		6 x 6 x ⅜		105.5		135.0
391.4		6 x 4 x ½		110.7		87.8
403.7		5 x 3½ x ⅝		113.1		87.8
430.3		6 x 6 x ½		124.3		135.0
460.0		5 x 3½ x ¾		125.1		87.8
462.4		6 x 4 x ⅝		125.9		87.8
503.3		6 x 4 x ⅜	14 x ⅜	95.1	35.7	87.8
510.5		6 x 6 x ⅝		142.7		135.0
530.2		6 x 4 x ¾		140.3		87.8
531.6		6 x 6 x ⅜	14 x ⅜	105.5	35.7	135.0

RIVETED PLATE GIRDERS.—*Continued*

Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
36 x ⅜	5 x 3½ x ½	12 x ½	100.3	40.8	87.8
	6 x 4 x ⅜	14 x ½	95.1	47.6	87.8
	6 x 6 x ⅜	14 x ½	105.5	47.6	135.0
	6 x 4 x ⅞		154.7		87.8
	5 x 3½ x ½	12 x ⅝	100.3	51.0	87.8
	6 x 4 x ½	14 x ½	110.7	47.6	87.8
	6 x 6 x ⅜	14 x ⅝	105.5	59.5	135.0
	5 x 3½ x ⅝	12 x ⅝	113.1	51.0	87.8
	6 x 6 x ½	14 x ½	124.3	47.6	135.0
	6 x 4 x ½	14 x ⅝	110.7	59.5	87.8
	6 x 6 x ½	14 x ⅝	124.3	59.5	135.0
	6 x 4 x ⅝	14 x ⅝	125.9	59.5	87.8
	6 x 6 x ½	14 x ¾	124.3	71.4	135.0
	6 x 6 x ⅝	14 x ⅝	142.7	59.5	135.0
	6 x 4 x ⅝	14 x ¾	125.9	71.4	87.8
	6 x 6 x ⅝	14 x ¾	142.7	71.4	135.0
	6 x 4 x ¾	14 x ¾	140.3	71.4	87.8
36 x 7/16	5 x 3½ x ½		108.0		102.4
	6 x 4 x ½		118.4		102.4
	5 x 3½ x ⅝		120.8		102.4
	6 x 6 x ½		132.0		157.5
	5 x 3½ x ¾		132.8		102.4
	6 x 4 x ⅝		133.6		102.4
	6 x 6 x ⅝		150.4		157.5
	6 x 4 x ¾		148.0		102.4
	5 x 3½ x ½	12 x ½	108.0	40.8	102.4
	6 x 4 x ⅞		162.4		102.4
	5 x 3½ x ½	12 x ⅝	108.0	51.0	102.4
	6 x 4 x ½	14 x ½	118.4	47.6	102.4
	5 x 3½ x ⅝	12 x ⅝	120.8	51.0	102.4
	6 x 6 x ½	14 x ½	132.0	47.6	157.5
	6 x 4 x ½	14 x ⅝	118.4	59.5	102.4
	6 x 6 x ½	14 x ⅝	132.0	59.5	157.5
	6 x 4 x ⅝	14 x ⅝	133.6	59.5	102.4
	6 x 6 x ½	14 x ¾	132.0	71.4	157.5
	6 x 6 x ⅝	14 x ⅝	150.4	59.5	157.5
	6 x 4 x ⅝	14 x ¾	133.6	71.4	102.4
	6 x 6 x ⅝	14 x ¾	150.4	71.4	157.5
	6 x 4 x ¾	14 x ¾	148.0	71.4	102.4

RIVETED PLATE GIRDERS.—*Continued*

Section Modulus, Axis 1–1, Inches^3	Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
	Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
418.0	36 x ½	6 x 4 x ½		126.0		117.0
456.9		6 x 6 x ½		139.6		180.0
489.0		6 x 4 x ⅝		141.2		117.0
537.1		6 x 6 x ⅝		158.0		180.0
556.9		6 x 4 x ¾		155.6		117.0
614.5		6 x 6 x ¾		176.0		180.0
621.9		6 x 4 x ⅞		170.0		117.0
662.5		6 x 4 x ½	14 x ½	126.0	47.6	117.0
689.2		6 x 6 x ⅞		193.6		180.0
700.3		6 x 6 x ½	14 x ½	139.6	47.6	180.0
723.7		6 x 4 x ½	14 x ⅝	126.0	59.5	117.0
761.3		6 x 6 x ½	14 x ⅝	139.6	59.5	180.0
792.3		6 x 4 x ⅝	14 x ⅝	141.2	59.5	117.0
822.3		6 x 6 x ½	14 x ¾	139.6	71.4	180.0
838.8		6 x 6 x ⅝	14 x ⅝	158.0	59.5	180.0
853.2		6 x 4 x ⅝	14 x ¾	141.2	71.4	117.0
899.4		6 x 6 x ⅝	14 x ¾	158.0	71.4	180.0
918.3		6 x 4 x ¾	14 x ¾	155.6	71.4	117.0
973.7		6 x 6 x ¾	14 x ¾	176.0	71.4	180.0
1039.4		6 x 4 x ¾	14 x 1	155.6	95.2	117.0
1094.1		6 x 6 x ¾	14 x 1	176.0	95.2	180.0
1101.1		6 x 4 x ⅞	14 x 1	170.0	95.2	117.0
1164.9		6 x 6 x ⅞	14 x 1	193.6	95.2	180.0
444.7	36 x ⅝	6 x 4 x ½		141.3		146.3
483.5		6 x 6 x ½		154.9		225.0
515.7		6 x 4 x ⅝		156.5		146.3
563.7		6 x 6 x ⅝		173.3		225.0
583.5		6 x 4 x ¾		170.9		146.3
641.2		6 x 6 x ¾		191.3		225.0
648.5		6 x 4 x ⅞		185.3		146.3
688.4		6 x 4 x ½	14 x ½	141.3	47.6	146.3
715.8		6 x 6 x ⅞		208.9		225.0
726.2		6 x 6 x ½	14 x ½	154.9	47.6	
749.4		6 x 4 x ½	14 x ⅝	141.3	59.5	146.3
787.0		6 x 6 x ½	14 x ⅝	154.9	59.5	225.0
818.1		6 x 4 x ⅝	14 x ⅝	156.5	59.5	146.3
847.9		6 x 6 x ½	14 x ¾	154.9	71.4	225.0
864.6		6 x 6 x ⅝	14 x ⅝	173.3	59.5	225.0
878.8		6 x 4 x ⅝	14 x ¾	156.5	71.4	146.3
924.9		6 x 6 x ⅝	14 x ¾	173.3	71.4	225.0

RIVETED PLATE GIRDERS.—*Continued*

Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
36 x ⅝	6 x 4 x ¾	14 x ¾	170.9	71.4	146.3
	6 x 6 x ¾	14 x ¾	191.3	71.4	225.0
	6 x 6 x ⅝	14 x 1	173.3	95.2	225.0
	6 x 4 x ¾	14 x 1	170.9	95.2	146.3
	6 x 6 x ¾	14 x 1	191.3	95.2	225.0
	6 x 4 x ⅞	14 x 1	185.3	95.2	146.3
	6 x 6 x ⅞	14 x 1	208.9	95.2	225.0
42 x ⅜	6 x 4 x ⅜		102.8		101.3
	6 x 6 x ⅜		113.2		157.5
	6 x 4 x ½		118.4		101.3
	6 x 6 x ½		132.0		157.5
	6 x 4 x ⅝		133.6		101.3
	6 x 4 x ⅜	14 x ⅜	102.8	35.7	101.3
	6 x 6 x ⅝		150.4.		157.5
	6 x 4 x ⅜	16 x ⅜	102.8	40.8	101.3
	6 x 4 x ¾		148.0		101.3
	6 x 6 x ⅜	14 x ⅜	113.2	35.7	157.5
	6 x 6 x ⅜	16 x ⅜	113.2	40.8	157.5
	6 x 4 x ⅜	14 x ½	102.8	47.6	101.3
	6 x 6 x ⅜	14 x ½	113.2	47.6	157.5
	6 x 6 x ¾		168.4		157.5
	6 x 4 x ⅞		162.4		101.3
	6 x 6 x ⅜	16 x ½	113.2	54.4	157.5
	6 x 4 x ½	14 x ½	118.4	47.6	101.3
	6 x 6 x ⅜	14 x ⅝	113.2	59.5	157.5
	6 x 4 x ½	16 x ½	118.4	54.4	101.3
	6 x 6 x ⅞		186.0		157.5
	6 x 6 x ½	14 x ½	132.0	47.6	157.5
	6 x 4 x ½	14 x ⅝	118.4	59.5	101.3
	6 x 6 x ½	16 x ½	132.0	54.4	157.5
	6 x 6 x ½	14 x ⅝	132.0	59.5	157.5
	6 x 4 x ⅝	14 x ⅝	133.6	59.5	101.3
	6 x 6 x ½	16 x ⅝	132.0	68.0	157.5
	6 x 6 x ½	14 x ¾	132.0	71.4	157.5
	6 x 4 x ⅝	16 x ⅝	133.6	68.0	101.3
	6 x 6 x ⅝	14 x ⅝	150.4	59.5	157.5
	6 x 4 x ⅝	14 x ¾	133.6	71.4	101.3
	6 x 6 x ⅝	16 x ⅝	150.4	68.0	157.5
	6 x 6 x ⅝	14 x ¾	150.4	71.4	157.5
	6 x 4 x ¾	14 x ¾	148.0	71.4	101.3
	6 x 6 x ⅝	16 x ¾	150.4	81.6	157.5

RIVETED PLATE GIRDERS.—*Continued*

Section Modulus, Axis 1–1, Inches³	Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
	Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
1130.4	42 x ⅜	6 x 4 x ¾	16 x ¾	148.0	81.6	101.3
1138.5		6 x 6 x ¾	14 x ¾	168.4	71.4	157.5
1194.1		6 x 6 x ⅝	16 x ⅞	150.4	95.2	157.5
1202.3		6 x 6 x ¾	16 x ¾	168.4	81.6	157.5
1283.5		6 x 6 x ¾	16 x ⅞	168.4	95.2	157.5
1286.4		6 x 4 x ⅞	16 x ⅞	162.4	95.2	101.3
1369.9		6 x 6 x ⅞	16 x ⅞	186.0	95.2	157.5
495.3	42 x 7/16	6 x 4 x ½		127.3		118.1
545.4		6 x 6 x ½		140.9		183.8
579.5		6 x 4 x ⅝		142.5		118.1
641.6		6 x 6 x ⅝		159.3		183.8
660.2		6 x 4 x ¾		156.9		118.1
734.7		6 x 6 x ¾		177.3		183.8
737.6		6 x 4 x ⅞		171.3		118.1
781.5		6 x 4 x ½	14 x ½	127.3	47.6	118.1
824.0		6 x 4 x ½	16 x ½	127.3	54.4	118.1
824.6		6 x 6 x ⅞		194.9		183.8
830.4		6 x 6 x ½	14 x ½	140.9	47.6	183.8
853.1		6 x 4 x ½	14 x ⅝	127.3	59.5	118.1
872.9		6 x 6 x ½	16 x ½	140.9	54.4	183.8
901.8		6 x 6 x ½	14 x ⅝	140.9	59.5	183.8
934.9		6 x 4 x ⅝	14 x ⅝	142.5	59.5	118.1
954.9		6 x 6 x ½	16 x ⅝	140.9	68.0	183.8
973.2		6 x 6 x ½	14 x ¾	140.9	71.4	183.8
988.1		6 x 4 x ⅝	16 x ⅝	142.5	68.0	118.1
995.3		6 x 6 x ⅝	14 x ⅝	159.3	59.5	183.8
1006.2		6 x 4 x ⅝	14 x ¾	142.5	71.4	118.1
1048.4		6 x 6 x ⅝	16 x ⅝	159.3	68.0	183.8
1066.2		6 x 6 x ⅝	14 x ¾	159.3	71.4	183.8
1084.1		6 x 4 x ¾	14 x ¾	156.9	71.4	118.1
1129.9		6 x 6 x ⅝	16 x ¾	159.3	81.6	183.8
1147.9		6 x 4 x ¾	16 x ¾	156.9	81.6	118.1
1156.0		6 x 6 x ¾	14 x ¾	177.3	71.4	183.8
1211.6		6 x 6 x ⅝	16 x ⅞	159.3	95.2	183.8
1219.8		6 x 6 x ¾	16 x ¾	177.3	81.6	183.8
1300.9		6 x 6 x ¾	16 x ⅞	177.3	95.2	183.8
1387.3		6 x 6 x ⅞	16 x ⅞	194.9	95.2	183.8
513.5	42 x ½	6 x 4 x ½		136.2		135.0
563.5		6 x 6 x ½		149.8		210.0
597.7		6 x 4 x ⅝		151.4		135.0
659.8		6 x 6 x ⅝		168.2		210.0
678.4		6 x 4 x ¾		165.8		135.0

RIVETED PLATE GIRDERS.—*Continued*

Section Modulus, Axis 1–1, Inches³	Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
	Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
752.8	42 x ½	6 x 6 x ¾		186.2		210.0
755.8		6 x 4 x ⅞		180.2		135.0
799.2		6 x 4 x ½	14 x ½	136.2	47.6	135.0
841.7		6 x 4 x ½	16 x ½	136.2	54.4	135.0
842.7		6 x 6 x ⅞		203.8		210.0
848.1		6 x 6 x ½	14 x ½	149.8	47.6	210.0
870.8		6 x 4 x ½	14 x ⅝	136.2	59.5	135.0
890.6		6 x 6 x ½	16 x ½	149.8	54.4	210.0
919.4		6 x 6 x ½	14 x ⅝	149.8	59.5	210.0
952.6		6 x 4 x ⅝	14 x ⅝	151.4	59.5	135.0
972.6		6 x 6 x ½	16 x ⅝	149.8	68.0	210.0
990.8		6 x 6 x ½	14 x ¾	149.8	71.4	210.0
1005.7		6 x 4 x ⅝	16 x ⅝	151.4	68.0	135.0
1012.9		6 x 6 x ⅝	14 x ⅝	168.2	59.5	210.0
1023.7		6 x 4 x ⅝	14 x ¾	151.4	71.4	135.0
1066.0		6 x 6 x ⅝	16 x ⅝	168.2	68.0	210.0
1083.7		6 x 6 x ⅝	14 x ¾	168.2	71.4	210.0
1101.7		6 x 4 x ¾	14 x ¾	165.8	71.4	135.0
1147.5		6 x 6 x ⅝	16 x ¾	168.2	81.6	210.0
1165.4		6 x 4 x ¾	16 x ¾	165.8	81.6	135.0
1173.6		6 x 6 x ¾	14 x ¾	186.2	71.4	210.0
1229.0		6 x 6 x ⅝	16 x ⅞	168.2	95.2	210.0
1237.4		6 x 6 x ¾	16 x ¾	186.2	81.6	210.0
1318.4		6 x 6 x ¾	16 x ⅞	186.2	95.2	210.0
1321.2		6 x 4 x ⅞	16 x ⅞	180.2	95.2	135.0
1404.7		6 x 6 x ⅞	16 x ⅞	203.8	95.2	210.0
466.9	48 x ⅜	6 x 4 x ⅜		110.4		121.5
512.7		6 x 6 x ⅜		120.8		180.0
567.4		6 x 4 x ½		126.0		121.5
628.9		6 x 6 x ½		139.6		180.0
664.9		6 x 4 x ⅝		141.2		121.5
714.4		6 x 4 x ⅜	14 x ⅜	110.4	35.7	121.5
741.3		6 x 6 x ⅝		158.0		180.0
750.8		6 x 4 x ⅜	16 x ⅜	110.4	40.8	121.5
758.5		6 x 4 x ¾		155.6		121.5
759.5		6 x 6 x ⅜	14 x ⅜	120.8	35.7	180.0
795.9		6 x 6 x ⅜	16 x ⅜	120.8	40.8	180.0
797.0		6 x 4 x ⅜	14 x ½	110.4	47.6	121.5
841.9		6 x 6 x ⅜	14 x ½	120.8	47.6	180.0
848.3		6 x 4 x ⅞		170.0		121.5
850.1		6 x 6 x ¾		176.0		180.0
890.4		6 x 6 x ⅜	16 x ½	120.8	54.4	180.0
895.5		6 x 4 x ½	14 x ½	126.0	47.6	121.5

Riveted Plate Girders.—*Continued*

Section Modulus, Axis 1-1, Inches³	Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
	Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
924.3	48 x ⅜	6 x 6 x ⅜	14 x ⅝	120.8	59.5	180.0
944.0		6 x 4 x ½	16 x ½	126.0	54.4	121.5
955.2		6 x 6 x ⅞		193.6		180.0
955.8		6 x 6 x ½	14 x ½	139.6	47.6	180.0
977.7		6 x 4 x ½	14 x ⅝	126.0	59.5	121.5
1004.3		6 x 6 x ½	16 x ½	139.6	54.4	180.0
1037.6		6 x 6 x ½	14 x ⅝	139.6	59.5	180.0
1072.7		6 x 4 x ⅝	14 x ⅝	141.2	59.5	121.5
1098.2		6 x 6 x ½	16 x ⅝	139.6	68.0	180.0
1119.5		6 x 6 x ½	14 x ¾	139.6	71.4	180.0
1133.3		6 x 4 x ⅝	16 x ⅝	141.2	68.0	121.5
1147.1		6 x 6 x ⅝	14 x ⅝	158.0	59.5	180.0
1154.4		6 x 4 x ⅝	14 x ¾	141.2	71.4	121.5
1207.8		6 x 6 x ⅝	16 x ⅝	158.0	68.0	180.0
1228.4		6 x 6 x ⅝	14 x ¾	158.0	71.4	180.0
1245.2		6 x 4 x ¾	14 x ¾	155.6	71.4	121.5
1301.2		6 x 6 x ⅝	16 x ¾	158.0	81.6	180.0
1317.9		6 x 4 x ¾	16 x ¾	155.6	81.6	121.5
1334.0		6 x 6 x ¾	14 x ¾	176.0	71.4	180.0
1394.7		6 x 6 x ⅝	16 x ⅞	158.0	95.2	180.0
1406.7		6 x 6 x ¾	16 x ¾	176.0	81.6	180.0
1498.1		6 x 4 x ⅞	16 x ⅞	170.0	95.2	121.5
1499.7		6 x 6 x ¾	16 x ⅞	176.0	95.2	180.0
1601.3		6 x 6 x ⅞	16 x ⅞	193.6	95.2	180.0
591.2	48 x 7/16	6 x 4 x ½		136.2		141.8
652.7		6 x 6 x ½		149.8		210.0
688.7		6 x 4 x ⅝		151.4		141.8
765.0		6 x 6 x ⅝		168.2		210.0
782.3		6 x 4 x ¾		165.8		141.8
872.1		6 x 4 x ⅞		180.2		141.8
873.8		6 x 6 x ¾		186.2		210.0
918.8		6 x 4 x ½	14 x ½	136.2	47.6	141.8
967.3		6 x 4 x ½	16 x ½	136.2	54.4	141.8
979.0		6 x 6 x ⅞		203.8		210.0
979.0		6 x 6 x ½	14 x ½	149.8	47.6	210.0
1000.8		6 x 4 x ½	14 x ⅝	136.2	59.5	141.8
1027.6		6 x 6 x ½	16 x ½	149.8	54.4	210.0
1060.8		6 x 6 x ½	14 x ⅝	149.8	59.5	210.0
1095.8		6 x 4 x ⅝	14 x ⅝	151.4	59.5	141.8
1121.4		6 x 6 x ½	16 x ⅝	149.8	68.0	210.0
1142.5		6 x 6 x ½	14 x ¾	149.8	71.4	210.0
1156.5		6 x 4 x ⅝	16 x ⅝	151.4	68.0	141.8

RIVETED PLATE GIRDERS.—*Continued*

Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
48 x 7/16	6 x 6 x ⅝	14 x ⅝	168.2	59.5	210.0
	6 x 4 x ⅝	14 x ¾	151.4	71.4	141.8
	6 x 6 x ⅝	16 x ⅝	168.2	68.0	210.0
	6 x 6 x ⅝	14 x ¾	168.2	71.4	210.0
	6 x 4 x ¾	14 x ¾	165.8	71.4	141.8
	6 x 6 x ⅝	16 x ¾	168.2	81.6	210.0
	6 x 4 x ¾	16 x ¾	165.8	81.6	141.8
	6 x 6 x ¾	14 x ¾	186.2	71.4	210.0
	6 x 6 x ⅝	16 x ⅞	168.2	95.2	210.0
	6 x 6 x ¾	16 x ¾	186.2	81.6	210.0
	6 x 4 x ⅞	16 x ⅞	180.2	95.2	141.8
	6 x 6 x ¾	16 x ⅞	186.2	95.2	210.0
	6 x 6 x ⅞	16 x ⅞	203.8	95.2	210.0
48 x ½	6 x 4 x ½		146.4		162.0
	6 x 6 x ½		160.0		240.0
	6 x 4 x ⅝		161.6		162.0
	6 x 6 x ⅝		178.4		240.0
	6 x 4 x ¾		176.0		162.0
	6 x 4 x ⅞		190.4		162.0
	6 x 6 x ¾		196.4		240.0
	6 x 4 x ½	14 x ½	146.4	47.6	162.0
	6 x 4 x ½	16 x ½	146.4	54.4	162.0
	6 x 6 x ½	14 x ½	160.0	47.6	240.0
	6 x 6 x ⅞		214.0		240.0
	6 x 4 x ½	14 x ⅝	146.4	59.5	162.0
	6 x 6 x ½	16 x ½	160.0	54.4	240.0
	6 x 6 x ½	14 x ⅝	160.0	59.5	240.0
	6 x 4 x ⅝	14 x ⅝	161.6	59.5	162.0
	6 x 6 x ½	16 x ⅝	160.0	68.0	240.0
	6 x 6 x ½	14 x ¾	160.0	71.4	240.0
	6 x 4 x ⅝	16 x ⅝	161.6	68.0	162.0
	6 x 6 x ⅝	14 x ⅝	178.4	59.5	240.0
	6 x 4 x ⅝	14 x ¾	161.6	71.4	162.0
	6 x 6 x ⅝	16 x ⅝	178.4	68.0	240.0
	6 x 6 x ⅝	14 x ¾	178.4	71.4	240.0
	6 x 4 x ¾	14 x ¾	176.0	71.4	162.0
	6 x 6 x ⅝	16 x ¾	178.4	81.6	240.0
	6 x 4 x ¾	16 x ¾	176.0	81.6	162.0
	6 x 6 x ¾	14 x ¾	196.4	71.4	240.0
	6 x 6 x ⅝	16 x ⅞	178.4	95.2	240.0
	6 x 6 x ¾	16 x ¾	196.4	81.6	240.0
	6 x 4 x ⅞	16 x ⅞	190.4	95.2	162.0
	6 x 6 x ¾	16 x ⅞	196.4	95.2	240.0
	6 x 6 x ⅞	16 x ⅞	214.0	95.2	240.0

RIVETED PLATE GIRDERS.—*Continued*

Section Modulus,	Size in Inches			Weight per Foot, Pounds		Maximum End Reaction in Thousands of Pounds
Axis 1-1, Inches^3	Web Plate	Flange Angles	Flange Plates	Web Plate and Flange Angles	Flange Plates	
194.7	24 x 5/16	6 x 6 x 3/8		85.1		67.5
245.7		6 x 6 x 1/2		103.9		67.5
294.2		6 x 6 x 5/8		122.3		67.5
340.7		6 x 6 x 3/4		140.3		67.5
200.6	24 x 3/8	6 x 6 x 3/8		90.2		81.0
251.5		6 x 6 x 1/2		109.0		81.0
300.1		6 x 6 x 5/8		127.4		81.0
346.6		6 x 6 x 3/4		145.4		81.0
216.6	26 x 5/16	6 x 6 x 3/8		87.2		78.8
272.9		6 x 6 x 1/2		106.0		78.8
326.7		6 x 6 x 5/8		124.4		78.8
378.2		6 x 6 x 3/4		142.4		78.8
223.5	26 x 3/8	6 x 6 x 3/8		92.8		94.5
279.8		6 x 6 x 1/2		111.6		94.5
333.6		6 x 6 x 5/8		130.0		94.5
385.2		6 x 6 x 3/4		148.0		94.5
230.4	26 x 7/16	6 x 6 x 3/8		98.3		110.3
286.7		6 x 6 x 1/2		117.1		110.3
340.5		6 x 6 x 5/8		135.5		110.3
392.1		6 x 6 x 3/4		153.5		110.3
227.8	27 x 5/16	6 x 6 x 3/8		88.3		78.8
286.8		6 x 6 x 1/2		107.1		78.8
343.1		6 x 6 x 5/8		125.5		78.8
397.3		6 x 6 x 3/4		143.5		78.8
235.2	27 x 3/8	6 x 6 x 3/8		94.0		94.5
294.2		6 x 6 x 1/2		112.8		94.5
350.6		6 x 6 x 5/8		131.2		94.5
404.7		6 x 6 x 3/4		149.2		94.5
242.7	27 x 7/16	6 x 6 x 3/8		99.8		110.3
301.7		6 x 6 x 1/2		118.6		110.3
358.1		6 x 6 x 5/8		137.0		110.3
412.2		6 x 6 x 3/4		155.0		110.3
271.2	30 x 3/8	6 x 6 x 3/8		97.9		108.0
338.3		6 x 6 x 1/2		116.7		108.0
402.6		6 x 6 x 5/8		135.1		108.0
464.4		6 x 6 x 3/4		153.1		108.0
280.4	30 x 7/16	6 x 6 x 3/8		104.2		126.0
347.5		6 x 6 x 1/2		123.0		126.0
411.8		6 x 6 x 5/8		141.4		126.0
473.6		6 x 6 x 3/4		159.4		126.0
289.6	30 x 1/2	6 x 6 x 3/8		110.6		144.0
356.7		6 x 6 x 1/2		129.4		144.0
421.0		6 x 6 x 5/8		147.8		144.0
482.8		6 x 6 x 3/4		165.8		144.0

COLUMNS AND STRUTS

Compression members in structures are called posts, struts or columns. No exact theoretical formula has been found which will give the strength of such members under various conditions of loading. The formulas in current use are based on the assumption that the members under stress may fail by direct compression, by compression and bending combined, or by bending alone. The empirical formulas based on these assumptions practically agree with results obtained by experiment on full size members. These experiments show that steel columns of ordinary sizes and lengths fail at nearly a constant stress which corresponds to the yield point of that material, and that the load which will cause a column to fail decreases as the ratio of its length to its least lateral dimension increases.

Radius of Gyration. As the strength of a column depends on its ability to resist flexural stress, the moment of inertia of its cross section is an important factor in the determination of its carrying capacity. For the purpose of computation, however, it is much more convenient to use the radius of gyration which depends on the moment of inertia.

Ratio of Slenderness. The ratio of slenderness is the unsupported length of a compression member divided by its radius of gyration, and the unsupported length of a column is determined by such points of support as will prevent deflection of the column in the direction which corresponds to the particular radius of gyration under consideration. Columns of unsymmetrical section have more than one radius of gyration. It is, therefore, necessary to determine the ratio of slenderness for the different radii of gyration of such columns and to use the proper ratio in any particular case.

The unit stresses for different ratios of slenderness given in the construction specifications and on page 682 are consistent with present practice in column construction and their use does not involve the refinements of the more complicated formulas, which refinements are often vitiated by uncertainties in the application of loads or other practical features.

The construction specifications limit the maximum ratio of slenderness to 120 for main members under steady stresses. For secondary members under temporary stress, such as those used in wind bracing, higher ratios may be used, but in no case should the ratio exceed 200.

Form and Size of Section. Important as it may be to have the metal in the column section distributed as far as possible from the neutral axis, that is, with as large a radius of gyration as possible, considerations of ease in fabrica-

COLUMNS AND STRUTS.—*Continued*

tion and simplicity in connections are of greater weight. The economical column section is not that which affords the least weight of metal in the shaft, but that which, with a reasonable radius of gyration, provides the least weight of member, shaft and details with the minimum amount of riveting. Modern practice, therefore, eliminates earlier forms of construction which represented the minimum amount of metal for the maximum radius of gyration, such, for example, as the column composed of three I-beams or one I-beam and two channels placed either with the flanges in or the flanges out. The Z-bar column has also fallen into disuse, likewise a number of patented sections and other sections.

The most practical column is one the surfaces of which are readily accessible for painting and, therefore, it is desirable to use open angle and plate columns rather than closed channel and plate columns.

The column sections should be of such size as to permit ready framing of beams and girders thereto and so placed in the construction as to permit the simplest details. Experience indicates that eight inches is the smallest desirable dimension in ordinary building work. For struts and light loads, smaller angle columns are still in use, while the H-beams are excellent for such purposes. I-beams and single angles may be used with economy where the conditions of lengths and loading permit.

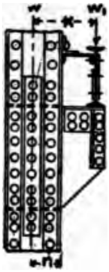
Explanation of Tables. The tables which immediately follow give the safe loads in thousands of pounds on H-beam and I-beam columns and on a selected line of plate and angle columns which, in the light of experience, seem to be desirable for use in ordinary building and bridge construction. In addition to the safe loads, they give moments of inertia and radii of gyration about both axes of symmetry, areas of sections, and weights in pounds per foot without allowance for rivet heads or other details.

These tables have been computed for the least radius of gyration in accordance with the formula given in the construction specifications. The values may be adjusted to other formulas or to different values of the ratio of slenderness by use of the comparative table on page 682. This table is also suitable for use in figuring columns so braced against flexure, that their safe strength may be computed for the greater radius of gyration.

Combined Bending and Compression Stresses. It is assumed in the tables that the loads are direct and equally distributed over the cross section of the column or balanced on opposite sides thereof. In the case of beams carried

Columns and Struts.—*Continued*

on brackets or other forms of eccentric loading, bending stresses are produced which should be taken into consideration and the column sections so proportioned that the combined fiber stresses do not exceed the allowable axial compressive stresses. There is no direct simple solution of this problem; the following trial method is suited to the tables:



Let

W = Direct load in pounds.

W_1 = Eccentric load in pounds.

M = Bending moment due to eccentric load in inch pounds = W_1X

I = Moment of inertia of column in direction of bending.

n = Extreme fiber distance in direction of bending.

A = Area of column section, in square inches.

f = Allowable axial unit compression in pounds per square inch;

then f should be equal to or greater than $\frac{W + W_1}{A} + \frac{Mn}{I}$ the fiber stresses due to compression and bending respectively.

Rule: Assume a section in excess of that required for the direct compression $W + W_1$ and compute the combined fiber stress. If it works out too large or too small, try again.

Example: Required to select a plate and angle column 20 feet long to sustain a balanced load of 210,000 pounds and an eccentric load of 40,000 pounds applied 15 inches from the column center on axis 1–1.

Assume a section made up of 14" x ⅜" web plate, four angles 6" x 4" x $\frac{7}{16}$" and two flange plates 14" x ⅜", page 689.

$A = 32.47$, $I_{1-1} = 1351$, $r_{2-2} = 3.09$, ratio of slenderness $= 20 \times 12 \div 3.09 = 77$.

Allowable fiber stress, 19,000—100 l/r = 11,300 pounds per square inch, page 682.

Actual fiber stress $= \frac{210,000 + 40,000}{32.47} + \frac{40,000 \times 15 \times 7.625}{1351} = 7,700 + 3,390 = 11,090$ pounds per square inch.

COLUMN SAFE LOADS

COMPARISON OF COMPRESSION FORMULAS

Allowable Unit Stresses in Pounds per Square Inch

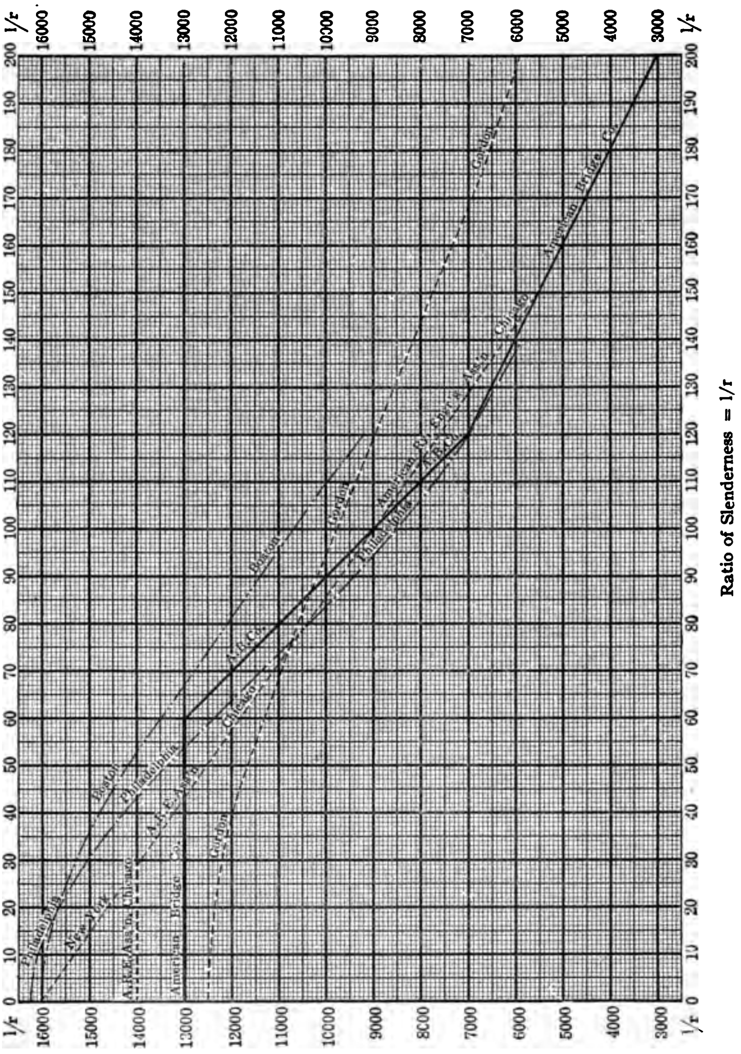
Ratio	American Bridge Co.	A.R.E. Ass'n Chicago	New York	Boston	Philadelphia	Gordon
$\frac{l}{r}$	See Construction Specifications	$16000-70\frac{l}{r}$ 14000 max.	$16000-70\frac{l}{r}$ 16000 max.	$\frac{16000}{1+\frac{l^2}{20000\,r^2}}$	$\frac{16250}{1+\frac{l^2}{11000\,r^2}}$	$\frac{12500}{1+\frac{l^2}{36000\,r^2}}$
0	13000	14000	16000	16000	16250	12500
5	13000	14000	15650	15980	16215	12490
10	13000	14000	15300	15920	16100	12460
15	13000	14000	14950	15820	15925	12420
20	13000	14000	14600	15690	15680	12365
25	13000	14000	14250	15515	15375	12285
30	13000	13900	13900	15310	15020	12195
35	13000	13550	13550	15075	14620	12090
40	13000	13200	13200	14815	14185	11970
45	13000	12850	12850	14530	13725	11835
50	13000	12500	12500	14220	13240	11690
55	13000	12150	12150	13900	12745	11530
60	13000	11800	11800	13560	12240	11365
65	12500	11450	11450	13210	11740	11185
70	12000	11100	11100	12850	11240	11000
75	11500	10750	10750	12490	10750	10810
80	11000	10400	10400	12120	10275	10615
85	10500	10050	10050	11755	9810	10410
90	10000	9700	9700	11390	9360	10205
95	9500	9350	9350	11025	8930	9995
100	9000	9000	9000	10670	8510	9785
105	8500	8650	8650	10315	8115	9570
110	8000	8300	8300	9970	7740	9355
115	7500	7950	7950	9630	7380	9140
120	7000	7600	7600	9300	7035	8930
125	6750	7250			6715	8715
130	6500	6900			6405	8510
135	6250	6550			6115	8300
140	6000	6200			5840	8095
145	5750	5850				7890
150	5500	5500				7690
155	5250					7495
160	5000					7305
165	4750					7120
170	4500					6935
175	4250					6755
180	4000					6580
185	3750					6410
190	3500					6240
195	3250					6080
200	3000					5920

Maximum Ratios of $\frac{l}{r}$

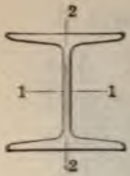
Compression Formula	Main Members	Secondary Members	Compression Formula	Main Members	Secondary Members
American Bridge Co. . .	120	200	New York Bldg. Law	120	120
American Ry. Eng. Ass'n	100	120	Boston Bldg. Law . . .	120	120
Chicago Bldg. Law . . .	120	150	Phila. Bldg. Law	140	140

COLUMN SAFE LOADS.—*Continued*

COMPARATIVE DIAGRAM OF COMPRESSION FORMULAS



ALLOWABLE UNIT STRESSES IN POUNDS PER SQUARE INCH



COLUMNS

BEAM COLUMNS

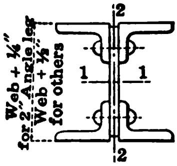
SAFE LOADS IN THOUSANDS OF POUNDS

Allowable Fiber Stress per square inch, 13,000 pounds for lengths of 60 radii or under; reduced for lengths over 60 radii, see specifications, page 549.

Weights do not include details.

Effective Length in Feet	Depth and Weight of Sections												
	H Beams				I Beams								
	8 in. 34 lbs.	6 in. 23.8 lbs.	5 in. 18.7 lbs.	4 in. 13.6 lbs.	15 in. 42 lbs.	12 in. 31½ lbs.	10 in. 25 lbs.	9 in. 21 lbs.	8 in. 18 lbs.	7 in. 15 lbs.	6 in. 12¼ lbs.	5 in. 9¾ lbs.	4 in. 7½ lbs.
2	130.0	91.0	71.5	52.0	162.2	120.4	95.8	82.0	69.3	57.5	46.9	37.3	28.7
3	130.0	91.0	71.6	52.0	162.2	120.4	95.8	82.0	69.3	57.5	46.9	37.3	28.5
4	130.0	91.0	71.5	52.0	162.2	120.4	95.8	82.0	69.3	56.8	44.5	33.3	24.0
5	130.0	91.0	71.5	50.7	162.2	120.4	94.4	77.8	63.2	50.0	38.5	28.0	19.5
6	130.0	91.0	71.5	45.7	153.9	109.9	85.3	69.4	55.6	43.2	32.5	22.7	15.2
7	130.0	91.0	66.0	40.6	140.1	98.9	76.2	61.0	48.0	36.4	26.5	18.8	13.0
8	130.0	86.7	60.5	35.6	126.2	87.9	67.1	52.6	40.4	30.3	22.9	16.1	10.8
9	130.0	80.9	55.0	30.5	112.3	76.9	58.0	44.2	35.0	26.9	19.9	13.5	8.5
10	125.8	75.1	49.5	26.7	98.5	65.9	50.2	40.0	31.2	23.5	16.8	10.8	
11	119.4	69.3	44.0	24.2	86.0	59.9	45.7	35.8	27.4	20.1	13.8		
12	113.0	63.5	38.5	21.7	79.0	54.4	41.1	31.5	23.6	16.7	10.8		
13	106.6	57.7	35.8	19.2	72.1	48.9	36.5	27.3	19.8	13.3			
14	100.2	51.9	33.0	16.6	65.2	43.4	32.0	23.1	16.0				
15	93.8	47.6	30.3	14.1	58.2	37.9	27.4	18.9					
16	87.3	44.7	27.5		51.3	32.4	22.9						
17	80.9	41.8	24.8		44.4	26.9							
18	74.5	38.9	22.0		37.4								
19	69.0	36.0	19.3										
20	65.8	33.1	16.5										
21	62.6	30.2											
22	59.4	27.3											
23	56.2	24.4											
24	53.0	21.5											
25	49.8												
26	46.6												
27	43.4												
28	40.2												
29	37.0												
30	33.7												
31	30.5												
Area, in.^{2}	10.00	7.00	5.50	4.00	12.48	9.26	7.37	6.31	5.33	4.42	3.61	2.87	2.21
I_{1-1}, in.^{4}	115.4	45.1	23.8	10.7	441.8	215.8	122.1	84.9	56.9	36.2	21.8	12.1	6.0
r_{1-1}, in.	3.40	2.54	2.08	1.63	5.95	4.83	4.07	3.67	3.27	2.86	2.46	2.05	1.64
I_{2-2}, in.^{4}	35.1	14.7	7.9	3.6	14.6	9.5	6.9	5.2	3.8	2.7	1.9	1.2	0.77
r_{2-2}, in.	1.87	1.45	1.20	0.95	1.08	1.01	0.97	0.90	0.84	0.78	0.72	0.65	0.59
Weight, Lbs. per Foot	34	23.8	18.7	13.6	42	31½	25	21	18	15	12¼	9¾	7½

Safe load values above upper zigzag line are for ratios of l/r not over 60, those between the zigzag lines are for ratios up to 120 l/r and those below zigzag line are for ratios not over 200 l/r.



COLUMNS.—*Continued*

PLATE AND ANGLE COLUMNS

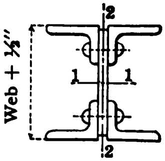
SAFE LOADS IN THOUSANDS OF POUNDS

Allowable Fiber Stress per square inch, 13,000 pounds for lengths of 60 radii or under; reduced for lengths over 60 radii, see specifications, page 549.

Weights do not include rivet heads or other details.

Effective Length in Feet	Web Plate 6x¼			Web Plate 8x¼				Web Plate 8x5/16				Web Plate 8x⅜		
	4 Angles 2½ x 2 x ¼	4 Angles 3 x 2 x ¼	4 Angles 3 x 2½ x ¼	4 Angles 3 x 2½ x ¼	4 Angles 3 x 2½ x 5/16	4 Angles 3½ x 2½ x ¼	4 Angles 3½ x 2½ x 5/16	4 Angles 3½ x 2½ x 5/16	4 Angles 3½ x 2½ x ⅜	4 Angles 4 x 3 x 5/16	4 Angles 4 x 3 x ⅜	4 Angles 4 x 3 x ⅜	4 Angles 4 x 3 x 7/16	4 Angles 4 x 3 x ½
6	69	81	88	94	110	101	119	125	142	141	161	168	188	208
7	63	78	82	86	103	101	119	125	142	141	161	168	188	208
8	56	72	76	79	95	96	115	120	138	141	161	168	188	208
9	49	66	69	72	87	89	107	112	130	136	158	163	185	206
10	43	60	63	65	78	83	100	104	121	128	149	154	175	196
11	38	54	56	57	70	76	92	96	112	121	140	145	165	185
12	35	49	50	50	62	70	85	89	104	113	131	136	155	174
13	32	43	45	47	56	63	78	81	95	105	123	127	145	163
14	28	40	42	43	52	57	70	73	86	97	114	118	135	152
15	25	37	39	39	48	52	63	66	77	89	105	109	124	141
16	22	34	35	36	44	49	60	62	73	81	97	100	114	130
17	18	32	32	32	40	46	56	58	68	75	88	90	104	120
18		29	29	28	36	43	52	54	64	71	83	86	98	110
19		26	26	25	32	39	49	50	60	67	79	81	93	105
20		23	22		28	36	45	47	55	63	74	77	88	100
21		20				33	41	43	51	59	70	72	83	94
22						30	38	39	47	55	66	68	78	89
23						27	34	35	42	51	61	63	73	83
24						23	30	31	38	48	57	59	68	78
25									34	44	53	54	63	72
26										40	48	49	58	67
27										36	44	45	53	62
28											39	40	48	56
29														51
30														
Area, in.^{2}	5.74	6.26	6.74	7.24	8.48	7.76	9.12	9.62	10.94	10.86	12.42	12.92	14.48	16.00
I_{1-1}, in.^{4}	34.3	39.1	42.6	81.2	96.9	90.1	107	110	127	122	141	143	161	178
r_{1-1}, in.	2.45	2.50	2.51	3.35	3.38	3.41	3.43	3.38	3.40	3.35	3.36	3.33	3.34	3.33
I_{2-2}, in.^{4}	6.2	10.3	10.3	10.3	12.9	16.0	20.2	20.7	24.9	30.3	36.3	37.2	43.5	50.2
r_{2-2}, in.	1.04	1.28	1.24	1.19	1.23	1.44	1.49	1.47	1.51	1.67	1.71	1.70	1.73	1.77
Weight, Lbs. per Foot	19.6	21.5	23.1	24.8	29.2	26.4	31.2	32.9	37.3	37.3	42.5	44.2	49.4	54.6

Safe load values above and to right of upper zigzag line are for ratios of l/r not over 60, those between the zigzag lines are for ratios up to 120 l/r. and those below lower zigzag line are for ratios not over 200 l/r.



COLUMNS.—*Continued*

PLATE AND ANGLE COLUMNS.—*Continu*

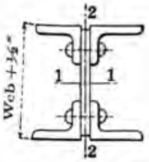
SAFE LOADS IN THOUSANDS OF POUNDS

Allowable Fiber Stress per square inch, 13,000 pounds for of 60 radii or under; reduced for lengths over 60 radii, see sp tions page 549.

Weights do not include rivet heads or other details.

Effective Length in Feet	Web Plate 10 x ¼			Web Plate 10 x 5/16			Web Plate 10 x ⅜							Web Pla 10 x ½	
	4 Angles 3 x2½x¼	4 Angles 3½x2½x¼	4 Angles 3½x2½x5/16	4 Angles 3½x2½x5/16	4 Angles 4 x 3 x5/16	4 Angles 4 x 3 x⅜	4 Angles 4 x 3 x⅜	4 Angles 4 x 3 x7/16	4 Angles 5 x3½x⅜	4 Angles 5 x3½x7/16	4 Angles 6 x 4 x⅜	4 Angles 6 x 4 x7/16	4 Angles 6 x 4 x½	4 Angles 6 x 4 x½	4 Angles 6 x 4 x9/16
6	99	107	125	133	149	170	178	198	207	232	236	266	296	312	341
7	91	107	125	133	149	170	178	198	207	232	236	266	296	312	341
8	82	100	119	125	149	170	178	198	207	232	236	266	296	312	341
9	74	93	111	117	142	164	170	192	207	232	236	266	296	312	341
10	66	86	103	108	133	154	160	181	207	232	236	266	296	312	341
11	58	79	95	99	125	145	150	170	203	230	236	266	296	312	341
12	52	71	87	91	116	135	140	160	194	220	236	266	296	312	341
13	48	64	79	82	108	126	130	149	185	210	235	266	296	312	341
14	44	57	71	73	99	117	121	138	175	200	226	257	288	302	333
15	40	54	65	68	91	107	111	127	166	190	218	248	278	291	321
16	36	50	61	64	82	98	101	116	157	180	209	238	267	280	309
17	32	47	57	60	77	90	93	106	148	170	201	229	257	269	297
18	28	43	53	55	73	85	88	101	139	160	192	220	247	258	285
19	24	40	49	51	69	81	83	95	130	150	184	210	237	247	274
20		36	45	47	64	76	78	90	121	140	175	201	226	236	262
21		33	41	42	60	71	73	84	112	130	167	191	216	225	250
22		29	37	38	56	67	68	79	107	123	158	182	206	214	238
23		25	34	34	51	62	63	74	103	118	150	172	195	203	226
24			30		47	57	58	68	98	113	141	163	185	192	214
25					43	52	53	63	93	108	132	154	175	181	203
26					39	48	48	57	89	103	126	144	164	170	191
27					34	43	43	52	84	98	121	139	157	164	181
28								47	80	93	117	134	152	158	175
29									75	88	113	130	146	153	169
30									71	83	109	125	141	147	164
rea, in.^{2}	7.74	8.26	9.62	10.25	11.49	13.05	13.67	15.23	15.95	17.87	18.19	20.47	22.75	24.00	26.24
$_{1-1}$, in.^{4}	134	148	176	181	201	232	237	267	279	315	319	361	401	412	451
$_{1-1}$, in.	4.16	4.23	4.28	4.20	4.18	4.22	4.17	4.19	4.18	4.20	4.19	4.20	4.20	4.14	4.15
$_{2-2}$, in.^{4}	10.3	16.0	20.2	20.7	30.3	36.3	37.2	43.5	70.6	82.3	119	139	160	165	186
$_{2-2}$, in.	1.15	1.39	1.45	1.42	1.62	1.67	1.65	1.69	2.10	2.15	2.56	3.61	2.65	2.62	2.66
Weight, Lbs. per Foot	26.5	28.1	32.9	35.0	39.4	44.6	46.8	52.0	54.4	60.8	62.0	70.0	77.6	81.8	89.4

Safe load values above and to right of upper zigzag line are for ratios of l/r not over 60, thos *igzag lines are* **for ratios up to 120 l/r, and those below lower zigzag line are for ratios not over**



Columns.—*Continued*

PLATE AND ANGLE COLUMNS.—*Continued*

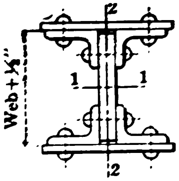
Safe Loads in Thousands of Pounds

Allowable Fiber Stress per square inch, 13,000 pounds for lengths of 60 radii or under; reduced for lengths over 60 radii, see specifications, page 549.

Weights do not include rivet heads or other details.

Effective Length in Feet	Web Plate 12 x ¼			Web Pl. 12 x 5/16		Web Plate 12 x ⅜						Web Plate 12 x ½					Web Pl	
																	12x [illegible]	12
	4 Angles 3½x2½x¼	4 Angles 3½x2½x5/16	4 Angles 4 x 3 x5/16	4 Angles 4 x 3 x5/16	4 Angles 4 x 3 x⅜	4 Angles 4 x 3 x⅜	4 Angles 5 x3½x⅜	4 Angles 5 x3½x7/16	4 Angles 5 x3½x½	4 Angles 6 x 4 x7/16	4 Angles 6 x 4 x½	4 Angles 6 x 4 x½	4 Angles 6 x 4 x9/16	4 Angles 6 x 4 x⅝	4 Angles 6 x 4 x11/16	4 Angles 6 x 4 x¾	4 Angles 6 x 4 x¾	
6	114	132	148	157	178	187	217	242	266	276	305	325	354	383	411	439	458	47
7	112	132	148	157	178	187	217	242	266	276	305	325	354	383	411	439	458	47
8	104	123	148	157	178	187	217	242	266	276	305	325	355	383	411	439	458	47
9	96	115	140	147	169	177	217	242	266	276	305	325	354	383	411	439	458	47
10	89	106	131	138	159	167	217	242	266	276	305	325	354	383	411	439	458	47
11	81	98	123	129	149	156	210	237	264	276	305	325	354	383	411	439	458	47
12	73	89	114	120	139	145	201	226	252	276	305	325	354	383	411	439	458	47
13	65	80	106	111	129	134	191	215	241	274	305	323	354	383	411	439	458	47
14	59	72	97	101	119	124	181	205	229	264	295	312	342	373	403	433	451	46
15	55	67	89	92	109	113	171	194	218	254	284	300	330	359	389	418	435	45
16	52	63	80	84	99	102	162	184	206	244	274	288	317	346	375	403	419	43
17	48	58	76	79	92	96	152	173	195	234	263	277	305	333	361	388	404	42
18	44	54	71	75	87	91	142	162	184	224	252	265	292	319	347	373	388	40
19	40	50	67	70	82	85	132	152	172	214	241	253	280	306	333	358	372	38
20	36	45	63	65	77	80	123	141	161	204	230	242	267	293	318	344	357	37
21	32	41	59	61	72	75	115	130	149	194	220	230	255	279	304	329	341	35
22	28	37	55	56	67	69	110	125	141	184	209	218	242	266	290	314	325	33
23		33	50	52	62	64	105	120	135	174	198	207	230	253	276	299	310	32
24			46	47	57	58	100	114	129	164	187	195	217	239	262	284	294	30
25			42	42	52	53	95	109	123	155	176	183	204	226	248	269	278	28
26			38	38	47	48	91	104	118	147	166	173	192	213	234	254	262	27
27					42		86	98	112	142	160	167	185	203	220	239	247	25
28							81	93	106	137	154	162	179	196	213	320	239	24
29							76	88	101	132	149	156	173	189	206	223	231	24
30							71	82	95	127	143	150	166	183	199	215	223	23
ea, .²	8.76	10.12	11.36	12.11	13.67	14.42	16.70	18.62	20.50	21.22	23.50	25.00	27.24	29.44	31.60	33.76	35.26	36.
in.⁴	222	264	295	304	350	359	421	476	526	544	605	623	683	741	794	849	867	88
in.	5.04	5.11	5.09	5.01	5.06	4.99	5.02	5.05	5.07	5.06	5.07	4.99	5.01	5.02	5.01	5.01	4.96	4.
in.⁴	16.0	20.2	29.6	30.3	36.3	37.3	70.6	82.3	94.6	139	160	165	186	206	228	249	257	2
in.	1.35	1.41	1.61	1.58	1.63	1.61	2.06	2.10	2.15	2.56	2.61	2.57	2.61	2.65	2.69	2.72	2.70	2.
ght per ot	29.8	34.6	39.0	41.6	46.8	49.3	56.9	63.3	69.7	72.5	80.1	85.2	92.8	100.4	107.6	114.8	119.9	12

fe load values above and to right of upper zigzag line are for ratios of l/r not over 60, those **between zi** are *for ratios up to 120 l/r,* and those below lower zigazg line are for ratios not over 200 l/r.



COLUMNS.—*Continued*

PLATE AND ANGLE COLUMNS.—*Continued*

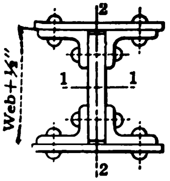
SAFE LOADS IN THOUSANDS OF POUNDS

Allowable Fiber Stress per square inch, 13,000 pounds for lengths of 60 radii or under; reduced for lengths over 60 radii, see specifications, page 549.

Weights do not include rivet heads or other details.

Effective Length in Feet	Web Plate 12 x 3/8				Web Plate 12 x 1/2				Web Plate 12 x 5/8			
	4 Angles 6 x 4 x 3/8 2 Plates 14 x 3/8	4 Angles 6 x 4 x 3/8 2 Plates 14 x 1/2	4 Angles 6 x 4 x 7/16 2 Plates 14 x 1/2	4 Angles 6 x 4 x 1/2 2 Plates 14 x 1/2	4 Angles 6 x 4 x 1/2 2 Plates 14 x 1/2	3 Angles 6 x 4 x 1/2 2 Plates 14 x 5/8	4 Angles 6 x 4 x 9/16 2 Plates 14 x 5/8	4 Angles 6 x 4 x 5/8 2 Plates 14 x 5/8	4 Angles 6 x 4 x 5/8 2 Plates 14 x 5/8	4 Angles 6 x 4 x 5/8 2 Plates 14 x 3/4	4 Angles 6 x 4 x 5/8 2 Plates 14 x 7/8	4 Angles 6 x 4 x 5/8 2 Plates 14 x 1
11	383	428	458	487	507	553	582	610	630	675	721	766
12	383	428	458	487	507	553	582	610	630	675	721	766
13	383	428	458	587	507	553	582	610	630	675	721	766
14	383	428	458	487	507	553	582	610	630	675	721	766
15	383	428	458	487	507	553	552	610	630	675	721	766
16	379	428	458	487	506	553	582	610	630	675	721	766
17	368	419	447	475	491	542	569	596	613	663	714	763
18	357	407	434	461	476	526	553	579	594	644	694	742
19	346	395	421	447	461	510	536	562	576	625	674	721
20	334	383	407	433	447	495	520	544	558	606	654	700
21	323	370	394	419	432	479	503	527	540	587	634	679
22	312	358	381	405	417	463	487	509	522	568	614	658
23	301	346	368	391	403	448	470	492	504	548	594	637
24	289	334	355	377	388	432	454	475	486	529	574	616
25	278	322	342	363	373	416	437	457	468	510	554	595
26	267	310	329	349	358	401	421	440	450	491	534	574
27	256	297	316	335	344	385	404	422	431	472	514	553
28	244	285	303	321	329	369	388	405	413	453	494	532
29	233	273	290	307	314	354	371	388	395	434	474	511
30	222	261	277	293	299	338	354	370	377	415	454	490
31	211	249	264	279	285	323	338	353	359	396	434	469
32	203	237	250	265	272	307	321	336	341	377	414	448
33	197	228	242	257	264	294	309	323	331	361	394	427
34	191	221	235	250	257	287	301	315	322	351	381	409
35	186	215	229	243	249	279	293	306	313	342	371	399
Area, in.^{2}	29.44	32.94	35.22	37.50	39.00	42.50	44.74	46.94	48.44	51.94	55.44	58.94
I_{1-1}, in.^{4}	916	1073	1136	1197	1215	1377	1437	1495	1513	1682	1856	2037
r_{1-1}, in.	5.58	5.71	5.68	5.65	5.58	5.69	5.67	5.64	5.59	5.69	5.79	5.88
I_{2-2}, in.^{4}	291	348	368	388	394	451	472	492	499	556	613	671
r_{2-2}, in.	3.14	3.25	3.23	3.22	3.18	3.26	3.25	3.24	3.21	3.27	3.33	3.37
Weight, Lbs. per Foot	100.2	112.1	120.1	127.7	132.8	144.7	152.3	159.9	165.0	176.9	188.8	200.7

Safe load values above and to right of upper zigzag line are for ratios of l/r not over 60, those between zigzag lines are for ratios up to 120 l/r, and those below lower zigzag line are for ratios not over 200 l/r.



COLUMNS.—*Continued*

PLATE AND ANGLE COLUMNS.—*Continued*

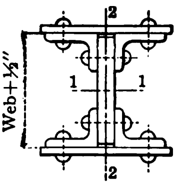
SAFE LOADS IN THOUSANDS OF POUNDS

Allowable Fiber Stress per square inch, 13,000 pounds for lengths of 60 radii or under; reduced for lengths over 60 radii, see specifications, page 549.

Weights do not include rivet heads or other details.

Effective Length in Feet	Web Plate 12 x ⅝								Web Plate 14 x ⅜				
	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1⅛	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1¼	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1⅜	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1½	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1⅝	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1¾	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1⅞	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 2	4 Angles 6 x 4 x ⅜ 2 Plates 14 x ⅜	4 Angles 6 x 4 x 7/16 2 Plates 14 x ⅜	4 Angles 6 x 4 x ½ 2 Plates 14 x ⅜	4 Angles 6 x 4 x ½ 2 Plates 14 x 7/16	4 Angles 6 x 4 x ½ 2 Plates 14 x ½
11	812	857	903	948	994	1039	1085	1130	392	422	452	474	497
12	812	857	903	948	994	1039	1085	1130	392	422	452	474	497
13	812	857	903	948	994	1039	1085	1130	392	422	452	474	497
14	812	857	903	948	994	1039	1085	1130	392	422	452	474	497
15	812	857	903	948	994	1039	1085	1130	392	422	452	474	497
16	812	857	903	948	994	1039	1085	1130	387	415	444	470	497
17	812	857	903	948	994	1039	1085	1130	375	403	431	456	482
18	791	840	888	937	986	1034	1082	1130	363	390	417	442	468
19	769	817	864	912	960	1007	1054	1101	352	377	404	428	453
20	747	794	840	887	934	980	1026	1072	340	365	390	415	439
21	725	771	817	862	908	953	998	1043	328	352	377	401	425
22	703	748	793	837	882	926	970	1014	317	340	363	387	410
23	681	725	769	812	856	899	942	985	305	327	350	373	396
24	659	702	745	787	830	872	914	956	293	314	336	359	381
25	637	679	721	762	805	845	886	927	281	302	323	345	367
26	615	657	697	738	779	818	858	898	270	289	309	331	353
27	593	634	673	713	753	791	830	869	258	276	296	317	338
28	571	611	649	688	727	764	802	840	246	264	282	303	324
29	549	588	625	663	701	737	774	811	235	251	269	289	309
30	527	565	601	638	675	710	746	782	223	239	255	275	295
31	505	542	577	613	649	684	718	753	211	227	243	261	281
32	483	519	553	588	623	657	690	725	205	220	236	251	267
33	461	496	529	563	597	630	662	696	200	214	229	244	260
34	439	473	505	538	571	603	634	667	194	208	222	237	253
35	427	456	484	513	545	576	606	638	188	201	216	230	245
Area, in.^{2}	62.44	65.94	69.44	72.94	76.44	79.94	83.44	86.94	30.19	32.47	34.75	36.50	38.25
I_{1-1}, in.^{4}	2224	2418	2618	2825	3038	3259	3486	3721	1261	1351	1436	1539	1643
r_{1-1}, in.	5.97	6.06	6.14	6.22	6.30	6.38	6.46	6.54	6.46	6.45	6.43	6.49	6.55
I_{2-2}, in.^{4}	728	785	842	899	956	1014	1071	1128	291	311	331	360	388
r_{2-2}, in.	3.41	3.45	3.48	3.51	3.54	3.56	3.58	3.60	3.10	3.09	3.09	3.14	3.19
Weight, Lbs. per Foot	212.6	224.5	236.4	248.3	260.2	272.1	284.0	295.9	102.8	110.8	118.4	124.3	130.3

Safe load values above and to right of upper zigzag line are for ratios of l/r not over 60, those between zigzag lines are for ratios up to 120 l/r, and those below lower zigzag line are for ratios not over 200 l/r.



COLUMNS.—*Continued*

PLATE AND ANGLE COLUMNS.—*Continued*

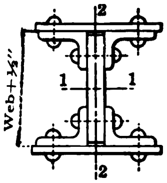
SAFE LOADS IN THOUSANDS OF POUNDS

Allowable Fiber Stress per square inch, 13,000 pounds for lengths of 60 radii or under; reduced for lengths over 60 radii, see specifications, page 549.

Weights do not include rivet heads or other details.

Effective Length in Feet	Web Plate 14 x ⅜		Web Plate 14 x ½			Web Plate 14 x ⅝						
	4 Angles 6 x 4 x ½ 2 Plates 14 x 9/16	4 Angles 6 x 4 x ½ 2 Plates 14 x ⅝	4 Angles 6 x 4 x ½ 2 Plates 14 x ⅝	4 Angles 6 x 4 x 9/16 2 Plates 14 x ⅝	4 Angles 6 x 4 x ⅝ 2 Plates 14 x ⅝	4 Angles 6 x 4 x ⅝ 2 Plates 14 x ⅝	4 Angles 6 x 4 x ⅝ 2 Plates 14 x ¾	4 Angles 6 x 4 x ⅝ 2 Plates 14 x ⅞	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1	4 Angles 6 x 4 x ⅝ 4 Plates 14 x 1⅛	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1¼	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1⅜
11	520	543	566	595	623	646	691	737	782	828	873	919
12	520	543	566	595	623	646	691	737	782	828	873	919
13	520	543	566	595	623	646	691	737	782	828	873	919
14	520	543	566	595	623	646	691	737	782	828	873	819
15	520	543	566	595	623	646	691	737	782	828	873	919
16	520	543	566	595	623	643	691	737	782	828	873	919
17	507	533	551	578	605	624	675	726	776	826	873	919
18	493	517	535	561	587	606	655	705	754	803	852	901
19	478	502	518	544	569	587	635	684	733	780	829	876
20	463	487	502	527	551	568	615	664	711	758	805	851
21	448	472	486	510	533	549	596	643	689	735	782	827
22	433	456	470	493	515	530	576	622	668	713	758	802
23	418	441	454	476	497	511	556	602	646	690	734	778
24	403	426	437	459	479	493	536	581	625	667	711	753
25	388	410	421	442	461	474	517	560	603	645	687	728
26	374	395	405	424	443	455	497	540	581	622	664	704
27	359	380	389	407	425	436	477	519	560	600	640	679
28	344	364	373	390	407	417	457	498	538	577	617	655
29	329	349	356	373	390	399	438	477	516	554	593	630
30	314	334	340	356	372	380	418	457	495	532	569	605
31	299	318	324	339	354	361	398	436	473	509	546	581
32	284	303	308	322	336	345	378	415	452	487	522	556
33	275	290	298	312	327	336	365	396	430	464	499	532
34	267	282	290	304	318	326	356	385	415	444	475	507
35	260	275	282	295	309	317	346	375	404	432	461	489
Area, in.^{2}	40.00	41.75	43.50	45.74	47.94	49.69	53.19	56.69	60.19	63.69	67.19	70.69
I_{1-1}, in.^{4}	1749	1857	1885	1970	2053	2081	2302	2529	2764	3006	3255	3512
r_{1-1}, in.	6.61	6.67	6.58	6.56	6.54	6.47	6.58	6.68	6.78	6.87	6.96	7.05
I_{2-2}, in.^{4}	417	446	451	472	492	499	556	613	671	728	785	842
r_{2-2}, in.	3.23	3.27	3.22	3.21	3.20	3.17	3.23	3.29	3.34	3.38	3.42	3.45
Weight, Lbs. per Foot	136.2	142.2	148.1	155.7	163.3	169.3	181.2	193.1	205.0	216.9	228.8	240.7

Safe load values above and to right of upper zigzag line are for ratios of l/r not over **60**, those between the zigzag lines are for ratios up to 120 l/r, and those below lower zigzag line are for *ratios not over 200 l/r.*



COLUMNS.—*Continued*

PLATE AND ANGLE COLUMNS.—*Continued*

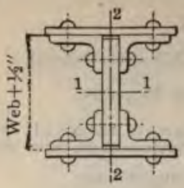
SAFE LOADS IN THOUSANDS OF POUNDS

Allowable Fibre Stress per square inch, 13,000 pounds for lengths of 60 radii or under; reduced for lengths over 60 radii, see specifications, page 549.

Weights do not include rivet heads or other details.

Effective Length in Feet	Web Plate 14 x ⅝											
	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1½	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1⅝	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1¾	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 1⅞	4 Angles 6 x 4 x ⅝ 2 Plates 14 x 2	4 Angles 6 x 4 x ⅝ 2 Plates 16 x 1⅞	4 Angles 6 x 4 x ⅝ 2 Plates 16 x 2	4 Angles 6 x 6 x ⅝ 2 Plates 16 x 2	4 Angles 6 x 6 x ⅝ 2 Plates 16 x 2⅛	4 Angles 6 x 6 x ⅝ 2 Plates 16 x 2¼	4 Angles 6 x 6 x ⅝ 2 Plates 16 x 2⅜	4 Angles 6 x 6 x ⅝ 2 Plates 16 x 2½
11	964	1010	1055	1101	1146	1198	1250	1315	1367	1419	1471	1523
12	964	1010	1055	1101	1146	1198	1250	1315	1367	1419	1471	1523
13	964	1010	1055	1101	1146	1198	1250	1315	1367	1419	1471	1523
14	964	1010	1055	1101	1146	1198	1250	1315	1367	1419	1471	1523
15	964	1010	1055	1101	1146	1198	1250	1315	1367	1419	1471	1523
16	964	1010	1055	1101	1146	1198	1250	1315	1367	1419	1471	1523
17	964	1010	1055	1101	1146	1198	1250	1315	1367	1419	1471	1523
18	949	998	1046	1095	1144	1198	1250	1315	1367	1419	1471	1523
19	924	971	1018	1067	1114	1198	1250	1315	1367	1419	1471	1523
20	898	945	991	1038	1084	1198	1250	1308	1364	1419	1471	1523
21	872	918	963	1010	1055	1174	1229	1277	1333	1388	1443	1497
22	847	892	935	981	1025	1146	1201	1246	1301	1356	1409	1463
23	821	865	908	953	996	1119	1172	1216	1269	1323	1375	1428
24	796	839	880	924	966	1091	1144	1185	1237	1290	1342	1393
25	770	812	853	895	937	1064	1115	1154	1206	1258	1308	1359
26	744	786	825	867	907	1036	1087	1123	1174	1225	1274	1324
27	719	759	797	838	877	1009	1058	1093	1142	1192	1241	1289
28	693	732	770	810	848	981	1030	1062	1111	1160	1207	1254
29	668	706	742	781	818	954	1001	1031	1079	1127	1173	1220
30	642	679	715	753	789	926	973	1000	1047	1094	1139	1185
31	617	653	687	724	759	899	944	970	1015	1062	1106	1150
32	591	626	659	696	730	871	916	939	984	1029	1072	1115
33	565	600	632	667	700	843	887	908	952	996	1038	1081
34	540	573	604	639	671	816	859	877	920	964	1005	1046
35	517	546	577	610	641	788	830	847	889	931	971	1011
Area, in.^{2}	74.19	77.69	81.19	84.69	88.19	92.19	96.19	101.19	105.19	109.19	113.19	117.19
I_{1-1}, in.^{4}	3776	4048	4327	4615	4910	5120	5457	5484	5830	6187	6552	6928
r_{1-1}, in.	7.13	7.22	7.30	7.38	7.46	7.45	7.53	7.36	7.44	7.53	7.61	7.69
I_{2-2}, in.^{4}	899	956	1014	1071	1128	1493	1579	1581	1666	1752	1837	1922
r_{2-2}, in.	3.48	3.51	3.53	3.56	3.58	4.02	4.05	3.95	3.98	4.01	4.03	4.05
Weight, Lbs. per Foot	252.6	264.5	276.4	288.3	300.2	313.8	327.4	344.2	357.8	371.4	385.0	398.6

Safe load values above and to right of upper zigzag line are for ratios of l/r not over 60, those between the zigzag lines are for ratios up to 120 l/r, and those below lower zigzag line are for ratios not over 200 l/r.



COLUMNS.—*Continued*

PLATE AND ANGLE COLUMNS.—*Continued*

SAFE LOADS IN THOUSANDS OF POUNDS

Allowable Fiber Stress per square inch, 13,000 pounds for lengths of 60 radii or under; reduced for lengths over 60 radii, see specifications, page 549.

Weights do not include rivet heads or other details.

Effective Length in Feet	Two Web Plates 14 x ½						Two Web Plates 14 x ⅝					
	4 Angles 6 x 6 x ⅝ 2 Plates 16 x 2½	4 Angles 8 x 6 x ⅝ 2 Plates 16 x 2½	4 Angles 8 x 6 x ⅝ 2 Plates 18 x 2⅜	4 Angles 8 x 6 x ⅝ 2 Plates 18 x 2½	4 Angles 8 x 6 x ⅝ 2 Plates 18 x 2⅝	4 Angles 8 x 6 x ⅝ 2 Plates 18 x 2¾	4 Angles 8 x 6 x ⅝ 2 Plates 18 x 2¾	4 Angles 8 x 6 x ⅝ 2 Plates 20 x 2⅝	4 Angles 8 x 6 x ⅝ 2 Plates 20 x 2¾	4 Angles 8 x 6 x ⅝ 2 Plates 20 x 2⅞	4 Angles 8 x 6 x ⅝ 2 Plates 20 x 3	4 Angles 8 x 6 x ⅝ 2 Plates 20 x 3⅛
11	1592	1657	1728	1787	1845	1904	1949	2027	2092	2157	2222	2287
12	1592	1657	1728	1787	1845	1904	1949	2027	2092	2157	2222	2287
13	1592	1657	1728	1787	1845	1904	1949	2027	2092	2157	2222	2287
14	1592	1657	1728	1787	1845	1904	1949	2027	2092	2157	2222	2287
15	1592	1657	1728	1787	1845	1904	1949	2027	2092	2157	2222	2287
16	1592	1657	1728	1787	1845	1904	1949	2027	2092	2157	2222	2287
17	1592	1657	1728	1787	1845	1904	1949	2027	2092	2157	2222	2287
18	1592	1657	1728	1787	1845	1904	1949	2027	2092	2157	2222	2287
19	1592	1657	1728	1787	1845	1904	1949	2027	2092	2157	2222	2287
20	1590	1657	1728	1787	1845	1904	1949	2027	2092	2157	2222	2287
21	1553	1653	1728	1787	1845	1904	1949	2027	2092	2157	2222	2287
22	1516	1616	1728	1787	1854	1904	1949	2027	2092	2157	2222	2287
23	1479	1580	1728	1787	1845	1904	1949	2027	2092	2157	2222	2287
24	1443	1543	1695	1756	1818	1879	1918	2027	2092	2157	2222	2287
25	1406	1507	1661	1721	1781	1842	1879	2027	2092	2157	2222	2287
26	1369	1470	1626	1685	1744	1804	1841	2009	2077	2146	2214	2283
27	1332	1434	1592	1650	1708	1766	1802	1972	2039	2107	2175	2242
28	1295	1397	1557	1614	1671	1729	1763	1935	2002	2068	2135	2202
29	1258	1360	1522	1578	1635	1691	1724	1899	1964	2029	2095	2161
30	1222	1324	1488	1543	1598	1653	1686	1862	1926	1991	2055	2120
31	1185	1287	1453	1507	1561	1616	1647	1825	1889	1952	2016	2079
32	1148	1251	1419	1471	1525	1578	1608	1789	1851	1913	1976	2039
33	1111	1214	1384	1436	1488	1541	1569	1752	1813	1874	1936	1998
34	1074	1177	1349	1400	1451	1503	1530	1715	1775	1836	1896	1957
35	1038	1141	1315	1365	1415	1465	1492	1679	1738	1797	1857	1916
Area, in.^{2}	122.44	127.44	132.94	137.44	141.94	146.44	149.94	155.94	160.94	165.94	170.94	175.94
I_{1-1}, in.^{4}	7014	7254	7559	7981	8415	8859	8916	9248	9741	10248	10767	11298
r_{1-1}, in.	7.57	7.54	7.54	6.62	7.70	7.78	7.71	7.70	7.78	7.86	7.94	8.01
I_{2-2}, in.^{4}	1946	2229	2831	2953	3074	3196	3222	4049	4216	4383	4549	4716
r_{2-2}, in.	3.99	4.18	4.61	4.63	4.65	4.67	4.64	5.10	5.12	5.14	5.16	5.18
Weight, Lbs. per Foot	416.4	433.6	452.3	467.6	482.9	498.2	510.1	530.5	547.5	564.5	581.5	598.5

Safe load values above and to right of zigzag line are for ratios of l/r not over 60, those below zigzag line are for ratios not over 120 l/r.

FLOORS AND ROOFS

MINIMUM LIVE LOADS, POUNDS PER SQUARE FOOT

By Building Laws of Various Cities

Description of Building	Baltimore, 1908	Boston, 1912	Chicago, 1911	Cleveland, 1911	New York, 1916	Philadelphia, 1913	Pittsburgh, 1914	St. Louis, 1910	San Francisco 1910
Apartment Houses, etc.:									
Floors	60	50	40	50	40	70	50	60	60
Hospitals, Asylums:									
Floors			50	60		70	70		60
Assembly Rooms, etc.			100	80		120	125		125
Hotels:									
Floors	60	50	50	50	40	70	70	60	60
Assembly Rooms, etc.	125	100	100	80	100	120	125	100	75
Factories:									
Floors, light manufacture	125a	125a	100a	125a	120a	120a	125a	150a	125a
Floors, heavier	175a			200a		150a			250a
Mercantile Buildings:									
Stores, light goods	125	125	100	100b	120	120	125	150	125
Stores, heavier goods	175	250		200		150	200	150	250
Warehouse floors	250	250		200		150	200	150	250
Office Buildings:									
Floors	75	100	50	60	60	100	70	70	60
Assembly Rooms, etc.	125	125	100	100	100	120	125	100	125
Public Assembly Halls:									
Auditoriums, fixed seats	75	125	100	80	100	120	125	100	75
Auditoriums, movable seats	125	125	100	100	100	120	125	100	125
Churches	75	125	100	80	100	120	125	100	75
Dance and Drill Halls		200	100	150			150		
Theatres	75	125	100	80	100	120	125	100	75
Schools:									
Class Rooms	75	60	40	60	75	70	70	100	75
Assembly Rooms, etc.	75	125	75	80	100	120	125	100	125
Sidewalks	200			200	300				150
Stables, Garages, etc.	100		100	80					75
Stairways, Fire Escapes		70	100	80					
Roofs:									
Flat, slope under 20°	40	40	25	40	40	30	50c	40	30
Steep, slope over 20°	20		25d	40d	30	30d	50c		20
Wind Pressure	30		20	30e	30	30e	25	30	20

a Floor loads do not include weight or impact load of machinery.
b Ground or First Floor: Baltimore 150, Cleveland 125, St. Louis 150 pounds.
c Dead and live load; snow load 25 pounds, reduced one pound for each degree between 20° and 45°.
d Load per square foot of superficial roof area; other roof loads are for the projected area.
e Wind pressure for high buildings in built-up districts 35 pounds; buildings fourteen stories high or over: 25 pounds at tenth story, 2½ pounds less each story below.

CONTENTS OF STORAGE WAREHOUSES

Material	Pounds per Cubic Foot of Space,	Height of Pile, Feet	Pounds per Square Foot of Floor	Recommende Live Loads, Pounds per Square Foot
Produce, Grain, Fruit, etc.				
Grain, in bulk				
Barley and Corn	37	8	296	250 to 30
Oats	26	8	208	
Rye and Wheat	48	8	384	
Fruit and Vegetables, in bulk				
Apples, Pears, etc	38	8	304	
Potatoes, Turnips, etc	44	8	352	
Miscellaneous Produce, packed				
Beans, in bags	40	8	320	
Corn in bags	31	8	248	
Cornmeal, in barrels	37	6½	240	
Oats, in bags	26	9	234	
Rice, in bags	58	5	290	
Wheat, in bags	39	8	312	
Wheat Flour, in barrels	40	7	280	
Hay, in bales, not compressed	14	9	126	
Hay, in bales, compressed	24	9	216	
Straw, in bales, compressed	19	9	171	
Groceries				
Miscellaneous Articles, packed				
Butter, Lard, etc., in barrels	32	6	192	250 to 30
Canned Goods, Preserves, etc.,in cases	58	6	348	
Cheese	30	8	240	
Coffee, green, in bags	39	8	312	
Coffee, roasted, in bags	33	8	264	
Dates and Figs, in cases, average	65	5	325	
Meat, Beef, Pork, etc., in barrels	37	5	185	
Molasses, in barrels	48	5	240	
Salt, finely ground, in sacks	60	5	300	
Soap Powder, in cases	38	8	288	
Starch, in barrels	25	7	175	
Sugar, in barrels	43	5	215	
Tea, in chests	25	8	200	
Wine, Liquors, etc., in barrels	48	5	240	
Dry Goods, Cotton, Wool, etc.				
Cotton, in bales, compressed, average	25	9	225	200 to 25
Cotton, unbleached goods, in bales	24	9	216	
Cotton, tickings and duck, in bales	35	8	280	
Cotton, printed goods, in bales	19	9	171	
Cotton, printed goods, in cases	31	8	248	
Cotton quilts and flannels, in cases	16	9	144	
Cotton yarn, in cases	25	8	200	
Hemp, in bales, compressed	22	8	176	
Hemp, Manila, in bales, compressed	26	9	234	
Hemp, Sisal, in bales, compressed	24	9	216	
Hemp, Tow, in bales, compressed	29	9	261	
Hemp, Burlaps, in bales, compressed	43	6	258	
Jute, in bales, compressed	41	6	246	
Linen, bleached goods, in cases	35	7	245	
Linen, damask goods, in cases	50	5	250	
Wool, in bales, not compressed	13	9	117	
Wool, in bales, compressed	48	5	240	
Wool, dress goods, flannels, in cases	18	9	162	
Wool, worsted goods, in cases	27	9	243	
Rags, in bales, compressed	19	9	171	
Excelsior, in bales, compressed	19	9	171	

CONTENTS OF STORAGE WAREHOUSES

Material	Pounds per Cubic Foot of Space	Height of Pile, Feet	Pounds per Square Foot of Floor	Recommended Live Loads, Pounds per Square Foot
gs, Oils, Paints, etc.				
:				
uriatic and Nitric, in carboys	45	1⅔	75	200 to 250
ulphuric, in carboys........	60	1⅔	100	
ia, in carboys..............	30	1⅔	50	
earl Alum, in barrels........	33	7	231	
ng Powder, in hogsheads......	31	3⅓	103	
Sulphate, Blue Vitriol, in bbls.	45	5	225	
austic Soda, in iron drums...	88	3⅓	294	
da Ash, in hogsheads.........	62	2¾	170	
ystals, Sal Soda, in barrels....	30	5	150	
itrate, Niter, in barrels.......	45	5	225	
licate, in barrels.............	53	5	265	
phate, White Vitriol, in bbls..	40	5	200	
Resins, etc.:				
e, in cases..................	52	6	312	
imal, Lard, etc., in barrels...	34	6	204	
getable, Linseed, in barrels...	36	6	216	
neral, Lubricants, in barrels..	35	6	210	
troleum, Kerosene, in bbls....	33	6	198	
phtha, Gasolene, in bbls......	28	6	168	
n barrels....................	48	6	288	
Gum, in boxes...............	38	6	228	
in barrels..................	37	6	222	
s, Paints, etc.:				
in boxes....................	43	6	258	
d Extract, in boxes..........	70	4½	315	
in boxes....................	39	5	195	
ad, Litharge, dry, in barrels..	132	3¾	495	
ead, dry, in barrels..........	86	4¾	409	
ead, paste, in cans..........	174	3½	609	
Building Materials				
atural, in barrels............	59	6	354	300 to 400
ortland, in barrels..........	73	6	438	
ck Lime, ground, in barrels..	50	5	250	
Paris, ground, in barrels.....	53	5	265	
eet Metal and Wire				
, in boxes...................	278	1½	417	300 to 400
lated copper, in coils........	63	5	315	
anized iron, in coils..........	74	4½	333	
net wire, on spools..........	75	6	450	
Miscellaneous				
, Glassware, in crates........	40	8	320	300 to 400
, Glassware, in casks.........	14	9	126	
oxes.......................	60	6	360	
, door and sash checks, in cases	46	6	276	
, hinges, in cases............	64	6	384	
, locks, in cases.............	31	6	186	
, screws, in boxes...........	101	4	404	
, not compressed, in bales...	13	10	130	
, compressed, in bales.......	23	10	230	
n bales.....................	16	10	160	
endered paper...............	50	6	300	
wspaper, manila, strawboards	35	6	210	
lting paper..................	64	6	384	
oils........................	42	6	252	

STEEL SHEET PILING

Steel Sheet Piling is now used for all purposes for which wood piling was formerly employed and for many others in which the use of wood piling would be impracticable. It is more economical than wood piling, although its first cost may be greater, for the reason that with proper care in driving, Steel Sheet Piling can be used repeatedly, and even after it has served its purpose many times it still has a comparatively high value as scrap metal, whereas, under ordinary working conditions, wood piling is so damaged in its first installation as to be practically worthless thereafter. For sewer and trench work it is admirably adapted to continuous construction, as on account of the facility with which it can be pulled and re-driven many times, a comparatively small quantity will suffice. It is largely used for coffer dams and deep water cribs, for temporary construction purposes. In constructing deep foundations for modern high buildings in large cities it is frequently necessary to excavate below the level of the foundations of adjoining buildings, in which case Steel Sheet Piling is driven to form a retaining wall during construction, and is sometimes left in as a permanent reinforcement of the concrete lining of basements. For permanent use, it is particularly adapted to the construction of dams, docks and dry docks, sea walls, water bulkheads, casings, breakwaters, wharves, dikes, locks and all other forms of construction where it is necessary to resist the percolation of water. It is also well suited for river and harbor protection, irrigation and reclamation projects, tunnel linings, wells, and many other purposes where timber is impracticable and pneumatic caissons expensive.

Steel Sheet Piling can be driven, under all conditions, more readily than wood, and will in many cases succeed where the use of wood is not practicable. Steel Sheet Piling can be furnished and driven in single lengths up to about 60 feet (18.3 meters) and can readily extend to greater depths by splicing, whereas the length of wood piling is limited. Wood piling generally involves waste in cutting, whereas Steel Sheet Piling is cut to the required lengths at the mills without waste. Steel Piling interlocks throughout its entire length, thereby producing water tight joints, whereas wood piling can be interlocked perfectly only in short lengths, and then does not produce water tight joints.

TYPES—Steel Sheet Piling is manufactured by the Carnegie Steel Company under three forms: United States Steel Sheet Piling, Friestedt Interlocking Channel Bar Piling and Symmetrical Interlock Channel Bar Piling. The sections and weights of these three forms are shown in the tables which follow. They have been thoroughly tried out in all classes of construction and under the most favorable as well as the most unfavorable conditions of driving. Each of these forms has its distinct advantages.

STEEL SHEET PILING.—*Continued*

The 9″ 16 pound (229 m/m, 23.81 kg. per lineal meter) United States Steel Sheet Piling and the 10″ 28 pound (254 m/m, 136.7 kg. per square meter) Symmetrical Interlock Channel Bar Piling are adapted for sewer and trench work, for shallow pits, for wells of small diameter, and any other places where the depths are not over 25 feet (7.6m), the soil not too compact to allow of easy driving, and the pressure not excessive.

The 12½″ (318 m/m) United States Steel Sheet Piling sections, the 12″ and 15″ (305 and 381 m/m) Friestedt Interlocking Channel Bar sections and the 12″ (305 m/m) Symmetrical Interlock Channel Bar sections are suitable, if sufficiently braced, for driving in most classes of material to the depths usual in foundation work; they have been driven to depths of 85 feet (25.9m). The 15″ (381 m/m) Symmetrical Interlock Channel Bar Piling, while suitable for medium construction, is particularly adapted to heavy construction, the great transverse strength of the heavier sections making them especially efficient for deep excavations and dams where high lateral pressure would otherwise require excessive bracing. While the choice of sections is in a way dependent upon the individual preferences of the user and his experience in the use of sheet piling, there are certain considerations which determine the suitability of each section for particular uses, which are fully explained in a special Steel Sheet Piling pamphlet, which will be furnished on request. In this pamphlet will be found valuable information as to the use of Steel Sheet Piling in various forms of construction, modes of driving the different sections, the proper appliances for same, etc.

STEEL SHEET PILING.—*Continued*

UNITED STATES STEEL SHEET PILING

United States Steel Sheet Piling is a simple, plain, rolled section ready for use as it comes from the mill without further fabrication. Each piece is complete in itself and all pieces of the same width are interchangeable. The strength of the section is uniform throughout and each pile of the same weight per foot is as strong as any other. In its profile it incorporates the advantages of the ball and socket joint, and with sufficient clearance in the interlock for ease of driving and sufficient space for the use of a packing substance between its adjacent edges to insure watertightness. The section has been designed on a scientific basis; contact between the head and the socket is made by lines and not by surfaces, so that the wedging action is prevented and the maximum strength is secured to resist forces in both lateral and longitudinal directions.

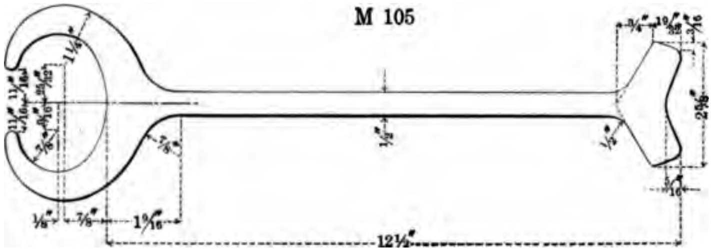
The joints are flexible and permit the entrance of silt and clay into the interlock to aid in securing watertightness. They permit also the easy passing of boulders, old logs and other obstructions encountered in driving, and the construction of circular or irregularly shaped pockets without the use of specially bent or fabricated pieces. In making closures for pockets, coffer dams, etc., such flexible joints allow distances to be gained or lost by longitudinal displacement in the joints themselves or by slight deflections from line. They are also an aid in bringing the piling back to its vertical alignment in either direction after a departure from it caused by meeting obstructions or careless driving. The clearance in the interlock between the ball and the socket is such as to insure ease in driving and pulling, but at the same time this clearance has been kept down to the minimum so as to make the section as nearly watertight as possible.

Tests under identical conditions and experience in use have proved beyond question that United States Steel Sheet Piling is more easily driven and pulled than any other section hitherto placed on the market. The reason for this is believed to be the absence of a leading groove, combined with the line contact obtained in the joints.

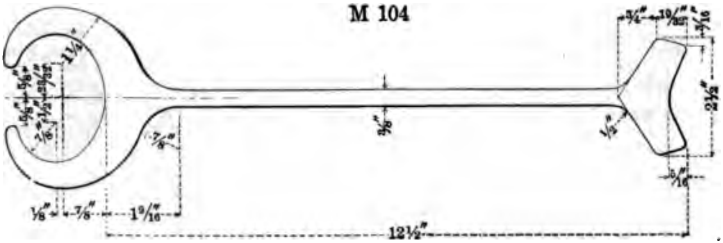
Steel Sheet Piling.—*Continued*

UNITED STATES STEEL SHEET PILING

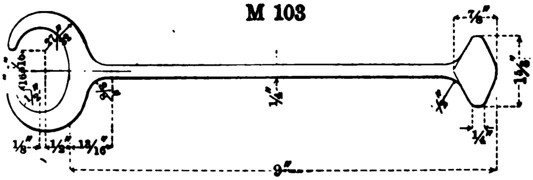
M 105



M 104



M 103



Dimensions of United States Steel Sheet Piling Sections

Note.—United States Steel Sheet Piling can only be furnished in the sizes and weights shown in the tables on page 700.

STEEL SHEET PILING.—*Continued*

TABLE I.—ELEMENTS OF UNITED STATES STEEL SHEET PILING

Section Index	Description		Area	Neutral Axis on Center Line of Web				Straight Section,	Regular Corner,
	Width, Inches	Weight, Lbs. per Lin. Ft.	Inches^2	I Inches^4	r Inches	S Inches^3	S* Inches^3	Weight, Pounds per Sq. Ft.	Weight, Pounds per Lin. Ft.
M 105	12½	43	12.72	9.20	0.85	4.53	4.10	39	43
M 104	12½	38	11.20	8.35	0.87	4.30	3.89	35	38
M 103	9	16	4.71	1.45	0.56	1.13	1.47	21	16

METRIC EQUIVALENTS OF ABOVE TABLE

Section Index	Description		Area	Neutral Axis on Center Line of Web				Straight Section, Weight, Kilos per Sq. Meter	Regular Corner, Weight, Kilos per Lin. Meter
	Width, Inches	Weight, Lbs. per Lin. Ft.	c/m.^{2}	I c/m^4	r m/m	S c/m^3	S* c/m^3		
M 105	12½	43	82.07	382.93	21.6	74.23	220.43	190.416	63.992
M 104	12½	38	72.26	347.55	22.1	70.47	209.14	170.884	56.550
M 103	9	16	30.39	60.35	14.2	18.52	79.03	102.531	23.811

S* is the average section modulus per horizontal foot of wall interlocked in place, based or average driving distances.

DRIVING WIDTHS.—The 12½" sections (M 104 and M 105) cannot driv less than 12⅞" (327 m/m); they may drive 13⅜" (340 m/m) and will avera about 13¼" (337 m/m); 91 pieces should drive 100 feet (30.5 m) of wall. T 9" section (M 103) cannot drive less than 9" (229 m/m); it may drive to 9 (238 m/m) and will average about 9¼" (235 m/m); 130 pieces should dr 100 feet (30.5 m).

For further particulars and data concerning United States Steel Sheet Pil see special pamphlet, "Steel Sheet Piling," which will be furnished on req

FRIESTEDT INTERLOCKING CHANNEL BAR PILING

Friestedt Interlocking Channel Bar Piling is a fabricated section made of channels and Z-bars; unsymmetrical as regards adjacent pieces, one channel having two Z-bars full length and the next adjacent channel being plain, that is, without Z-bars. The standard sections listed in the tables are made with 12" and 15" (305 and 381 m/m) channels and special Z-bars, but other sections can be furnished with any size or weight of channels which can be interlocked by the use of the special or standard Z-bar sections, thus permitting a large range of possible weights and sizes.

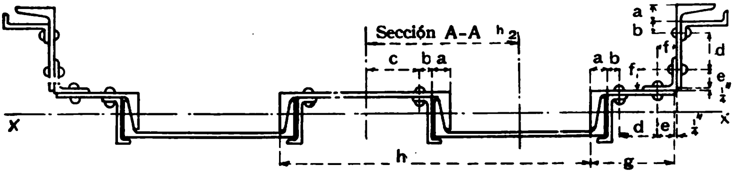
This type of piling section does not have the same strength in a longitudinal direction as the United States Steel Sheet Piling section; it has, however, sufficient strength for use in ordinary construction work. While the joints are not so flexible as in the case of the rolled section, there is a sufficient amount of flexibility to permit successful driving and pulling. When driven in a coffer dam or other structure sustaining lateral pressure from one side, the inner surfaces of the channels wedge tightly against each other so as to make the sections practically watertight without the use of packing strips or other packing material.

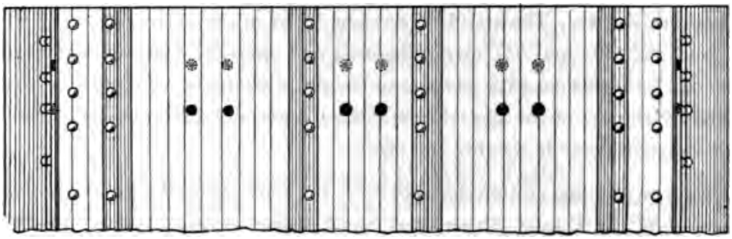
Inasmuch as every alternate piece is furnished plain with the exception of the pulling holes, the sections possess a high salvage value in that some 40% to 45% of the channels can be withdrawn and used for structural purposes after their temporary use as sheet piling has been completed.

The composition, dimensions, and properties of the standard sections are shown on the following pages. For further particulars, data and general information see special Steel Sheet Piling pamphlet, which will be furnished on request.

STEEL SHEET PILING.—*Continued*

FRIESTEDT INTERLOCKING CHANNEL BAR PILING





Assembly of Friedstedt Interlocking Channel Bar Piling

COMPOSITION AND DIMENSIONS OF SECTIONS

No.	Description	Channels		Z-bars		a Ins.	b Ins.	c Ins.	d Ins.	e Ins.	f Ins.	g Ins	h/2 Ins.
		Ins.	Lbs. per Ft.	Ins.	Lbs. per Ft.								
1	12" x 33 lbs.	12	20.5	3⅝ x ⅜	8.6	1⅜	1¼	3⅜	2¼	1⅛	1⅜	6	10⅞
2	12" x 38 lbs.	12	25	3⅝ x ⅜	8.6	1⅜	1¼	3⅜	2¼	1⅛	1⅜	6	10⅞
3	15" x 38 lbs.	15	33	4⅛ x ⅜	9.2	1 11/16	1 5/16	4½	3	1½	1¾	7½	13½
4	15" x 44 lbs.	15	40	4⅛ x ⅜	9.2	1 11/16	1 5/16	4½	3	1½	1¾	7½	13½

METRIC EQUIVALENTS OF ABOVE TABLES

No.	Description	Channels		Z-bars		a m/m	b m/m	c m/m	d m/m	e m/m	f m/m	g m/m	h/2 m/m
		m/m	Kilos per Meter	m/m	Kilos per Meter								
1	12"x33 lbs.	305	30.508	92x9.5	12.798	35	32	86	57	29	35	152	276
2	12"x38 lbs.	305	37.204	92x9.5	12.798	35	32	86	57	29	35	152	276
3	15"x38 lbs.	381	49.109	105x9.5	13.691	43	33	114	76	38	44	190	343
4	15"x44 lbs.	381	59.526	105x9.5	13.691	43	33	114	76	38	44	190	343

STEEL SHEET PILING.—*Continued*

FRIESTEDT INTERLOCKING CHANNEL BAR PILING

PROPERTIES OF SECTION AXIS X-X

No.	Description		Sections Interlocked					Z-Bar Channel			Plain Channel			Regula Corne Weigh per Lineal Foot
	Width Ins.	Lbs. per Sq. Ft.	Area	Moment of Inertia	Radius of Gyration	Section Modulus	S*	Moment of Inertia	Radius of Gyration	Section Modulus	Moment of Inertia	Radius of Gyration	Section Modulus	
			Ins.^{2}	Ins.^{4}	Ins.	Ins.^{3}	Ins.^{3}	Ins.^{4}	Ins.	Ins.^{3}	Ins.^{4}	Ins.	Ins.^{3}	Lbs.
1	12	33	8.54	14.54	1.30	6.84	7.55	17.18	1.25	6.53	3.91	.81	1.75	46
2	12	38	9.86	18.62	1.37	8.72	9.62	19.26	1.25	6.94	4.53	.79	1.91	51
3	15	38	12.60	28.90	1.51	11.74	10.44	28.70	1.37	8.98	8.23	.91	3.16	61
4	15	44	14.46	36.77	1.59	14.88	13.23	31.92	1.36	9.54	9.39	.89	3.43	68

METRIC EQUIVALENTS OF ABOVE TABLE

No.	Description		Sections Interlocked					Z-Bar Channel			Plain Channel			Regula Corne Weigh per Lineal Meter
	Width m/m	Kilos per Square Meter	Area	Moment of Inertia	Radius of Gyration	Section Modulus	S*	Moment of Inertia	Radius of Gyration	Section Modulus	Moment of Inertia	Radius of Gyration	Section Modulus	
			c/m^2	c/m^4	m/m	c/m^3	c/m^3	c/m^4	m/m	c/m^3	c/m^4	m/m	c/m^3	Kilos
1	305	161.120	55.10	605.20	33	112.08	405.91	715.08	32	107.00	162.75	20.6	28.68	68.45
2	305	185.532	63.61	775.02	35	142.90	517.19	801.66	32	113.73	188.55	20	31.30	75.89
3	381	185.532	81.29	1202.91	38.4	192.39	561.28	1194.58	35	147.16	342.56	23	51.78	90.77
4	381	214.826	93.29	1530.48	40.4	243.84	711.29	1328.61	34.5	156.33	390.84	22.6	56.21	101.19

*S is the average section modulus per horizontal foot of wall interlocked in place.

Friestedt Interlocking Channel Bar Piling can also be furnished with double interlock, that is, with two Z-bars on each piece, in which case the section possesses great stiffness and lateral strength and is suitable for very heavy and difficult driving conditions.

Driving Widths: The theoretical center to center driving distances of the Friestedt Interlocking Channel Bar Piling is shown in the table of the Composition and Dimensions of Sections, on page 702. The sections assemble very nearly to the widths given.

Steel Sheet Piling.—*Continued*

SYMMETRICAL INTERLOCK CHANNEL BAR PILING

Symmetrical Interlock Channel Bar Piling is a fabricated section made of channels and Z-bars in which each piece has a short Z-bar on one edge and a long Z-bar on the other. The long Z-bar forms the interlock with the next adjacent section while the short Z-bar serves to reinforce the top of the pile and to distribute the blow from the pile driving hammer uniformly over the width of the section. The lengths of the short Z-bars are proportioned to the length of the entire piece so as to afford ample stiffness at the top of the pile for various driving conditions, as per the following table:

Length of Piling		Length of Z-Bars	
Feet	Meters	Feet	Centimeters
20 and under	6.10 and under	2′-0″	61
20 to 30	6.10 to 9.14	2′-6″	76
30 to 40	9.14 to 12.19	3′ 0″	91
40 to 50	12.19 to 15.24	3′ 6″	107
50 to 60	15.24 to 18 29	4′-0″	122

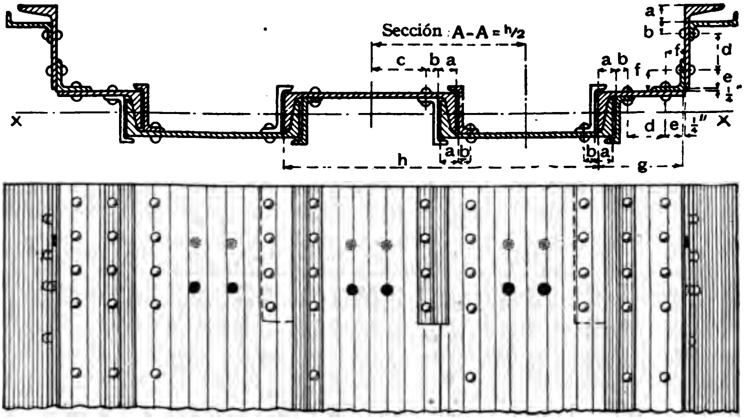
While the pieces are right and left as regards position in the line and are, therefore, denominated symmetrical, the strength of the sections is uniform throughout and each pile of the same weight per foot is as strong as any other. The section is not as strong in a longitudinal direction as the United States Steel Sheet Piling, but it possesses a high radius of gyration and a large section modulus which makes it, by reason of its great lateral strength and stiffness, the most suitable of all three types for use under difficult driving conditions.

The composition, dimensions, and properties of the standard sections are shown on the following pages. While the tables show only six standard sizes and weights, the piling can be manufactured, in a manner similar to the Friestedt Interlocking Channel Bar Piling, in a variety of sizes and weights to suit special conditions.

For further particulars, data, and general information, see special Steel Sheet Piling pamphlet, which will be furnished on request.

STEEL SHEET PILING.—*Continued*

SYMMETRICAL INTERLOCK CHANNEL BAR PILING



ASSEMBLY OF SYMMETRICAL INTERLOCK CHANNEL BAR PILING

COMPOSITION AND DIMENSIONS OF SECTIONS

No.	Description	Channels		Z-Bars		a	b	c	d	e	f	g	h/2
		Ins.	Lbs. per Ft.	Ins.	Lbs. per Ft.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
1	10"x28 lbs.	10	15	3⅛x¼	4.8	1 1/16	15/16	3	2	1	1¼	5	9
2	10"x34 lbs.	10	20	3⅛x¼	4.8	1 1/16	15/16	3	2	1	1¼	5	9
3	12"x34 lbs.	12	20.5	3⅝x⅜	8.6	1⅜	1¼	3⅜	2¼	1⅛	1⅜	6	10⅞
4	12"x39 lbs.	12	25	3⅝x⅜	8.6	1⅜	1¼	3⅜	2¼	1⅛	1⅜	6	10⅞
5	15"x39 lbs.	15	33	4⅛x⅜	9.2	1 11/16	1 5/16	4½	3	1½	1¾	7½	13½
6	15"x45 lbs.	15	40	4⅛x⅜	9.2	1 11/16	1 5/16	4½	3	1½	1¾	7½	13½

METRIC EQUIVALENTS OF ABOVE TABLE

No.	Description	Channels		Z-Bars		a	b	c	d	e	f	g	h/2
		m/m	Kilos per Meter	m/m	Kilos per Meter	m/m	m/m	m/m	m/m	m/m	m/m	m/m	m/m
1	10"x28 lbs.	254	22.323	79x6.35	7.143	27	24	76	51	25	32	127	229
2	10"x34 lbs.	254	29.764	79x6.35	7.143	27	24	76	51	25	32	127	229
3	12"x34 lbs.	305	30.508	92x9.5	12.798	35	32	86	57	29	35	152	276
4	12"x39 lbs.	305	37.205	92x9.5	12.798	35	32	86	57	29	35	152	276
5	15"x39 lbs.	381	49.110	105x9.5	13.691	43	33	114	76	38	44	190	343
6	15"x45 lbs.	381	59.527	105x9.5	13.691	43	33	114	76	38	44	190	343

SYMMETRICAL INTERLOCK CHANNEL BAR PILING

PROPERTIES OF SECTION, AXIS X-X

	Description		Sections Interlocked					Single Section			
No.	Width Ins.	Lbs. per Sq. Ft.	Area Ins.^{2}	Moment of Inertia Ins.	Radius of Gyration Ins.	Section Modulus Ins.^{3}	S* Ins.^{3}	Moment of Inertia Ins.	Radius of Gyration Ins.	Section Modulus Ins.^{3}	Regular Corner Wt. per Lineal Foot Lbs.
1	10	28	5.87	7.09	1.10	3.64	4.85	5.52	0.97	2.24	26
2	10	34	7.29	10.26	1.19	5.27	7.03	6.61	0.95	2.50	31
3	12	34	8.54	14.59	1.31	6.63	7.32	11.18	1.14	3.95	38
4	12	39	9.86	18.66	1.38	8.48	9.36	12.63	1.13	4.23	42
5	15	39	12.60	28.96	1.52	11.44	10.17	19.33	1.24	5.68	51
6	15	45	14.46	36.82	1.60	14.55	12.93	21.60	1.22	6.07	58

METRIC EQUIVALENTS OF ABOVE TABLE

	Description		Sections Interlocked					Single Section			
No.	Width m/m	Kilos per Square Meter	Area c/m^{2}	Moment of Inertia c/m^{4}	Radius of Gyration m/m	Section Modulus c/m^{3}	S* c/m^{3}	Moment of Inertia c/m^{4}	Radius of Gyration m/m	Section Modulus c/m^{3}	Regular Corner Wt. per Lineal Meter Kilos
1	254	136.707	37.87	295.11	28	59.65	260.76	229.76	25	36.71	38.692
2	254	166.002	47.03	427.05	30	86.36	377.95	275.13	24	40.97	46.133
3	305	166.002	55.10	607.28	33	108.65	393.55	465.35	29	64.73	56.550
4	305	190.414	63.61	776.69	35	138.96	503.22	525.70	29	69.32	62.503
5	381	190.414	81.29	1205.41	39	187.47	546.76	804.57	31.5	93.08	75.896
6	381	219.709	93.29	1532.56	41	238.43	695.18	899.06	31	99.47	86.313

S* is the average section modulus per horizontal foot of wall interlocked in place.

DRIVING WIDTHS.—The theoretical center to center driving distances of the symmetrical Interlock Channel Bar Piling is shown in the table of the Composition and Dimensions of Sections on page 705. The sections assemble very nearly to the widths given.

STEEL SHEET PILING.—*Continued*

METHOD OF ORDERING.—United States Steel Sheet Piling may be ordered by weight per square foot, weight per lineal foot or by section number. Fabricated sections must always be ordered by weight per square foot or section number as given in the tables of weights and proportions on pages 703 and 706. If, however, standard structural zee bars are used instead of the standard piling zee bars, the make-up of the sections should be distinctly stated on the order, which should specify the weight of the channel and the weight of the Z-bar per lineal foot which go to make up the component parts. Orders should specify in all cases the number of pieces and the length required, whether with or without pulling holes, and the number and style of corners, whether right or left hand. If corners are not square, the angle to which they are to be bent must be stated. Orders for junction pieces should specify the junction piece mark as indicated on the pages of constructional details (pages 709 and 710), Figs. 39 and 41. Piling should never be ordered by perimeter or girth of enclosure or by lineal feet, but always by the number of pieces and their length.

Steel Sheet Piling is estimated and invoiced at the theoretical weights of its component members.

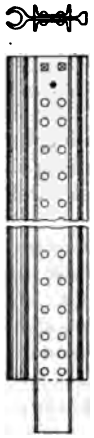


FIG. 37—FOLLOWER

FOLLOWERS

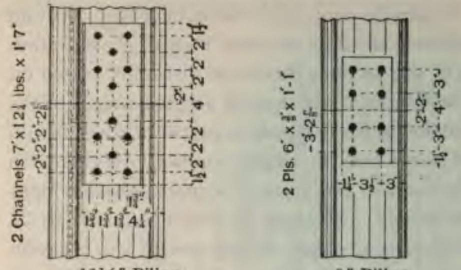
The usual method of driving steel sheet piling under water or below the ends of the pile driver leads is by the use of a follower made of a piece of piling, as shown in Fig. 37, with channels or projecting plates riveted thereto to fit over the section below. These followers are as a rule six or seven feet (1.83 m or 2.13 m) long but may of course be made to suit any conditions which arise.

SPLICED LENGTHS

9" (229 m/m) United States Steel Sheet Piling can be rolled in lengths up to 45 feet (13.72 m), and 12½" (318 m/m) section in lengths up to 60 feet (18.29 m), while the fabricated sections may be made in single lengths

STEEL SHEET PILING.—*Continued*

longer than this. Where, however, it is not desired to ship the piling in such long lengths, or the lengths needed are longer than can easily be rolled, or in cases where the head room will not permit the use of full length pieces, it can be driven in spliced lengths with or without splice plates, which are really necessary only where it is to be withdrawn and reused. As seen in Fig. 38, the splice plates or splice channels are riveted or bolted to the upper length of the piling, but connect to the lower length by bolts through slotted holes in the piling webs. The use of these slotted holes permits the blow of the pile driving hammer to be transmitted from the upper to the lower section without danger of shearing the bolts.



12½" Piling 9" Piling

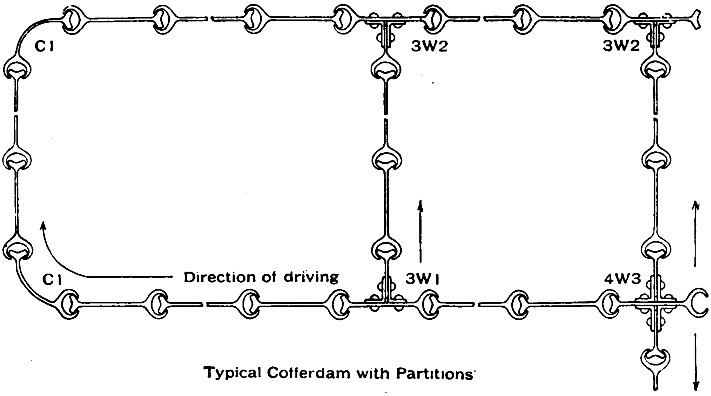
FIG. 38—STANDARD SPLICES

CORNER PIECES AND JUNCTION PIECES

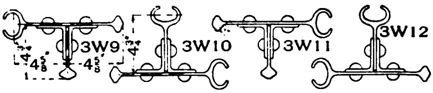
Corner pieces for United States Steel Sheet Piling, shown in Fig. 39 (page 709), are made by bending the sections to approximately 90 degrees in a gag press. Corner pieces for fabricated piling, shown in Fig. 41 (page 710), are made by splitting channels lengthwise and uniting the split portions by the use of bolts and rivets. . In an ordinary cofferdam driven continuously in one direction, the corner pieces are alike, and United States Steel Sheet Piling corners are reversible. When pulling holes are punched in the piling, all corner pieces are furnished with pulling holes at both ends, thus retaining the reversible feature. The corners for Symmetrical Interlock Channel Bar Piling are made with both zee bars full length so as to make them reversible. Orders for other than 90 degree corners must state inside angular measurement.

Junction pieces are made by splitting sections in half lengthwise and by riveting the half pieces or pieces through angles to an integral section. Different forms of corner pieces and three and four-way junction pieces are shown on the pages of Constructional Details (pages 709 and 710), Figs. 39 and 41, and may be ordered by the numbers given. The constructional details not only show typical positions of corner pieces and junction pieces, but also the preferable direction of driving.

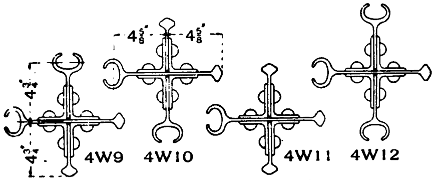
Steel Sheet Piling.—*Continued*



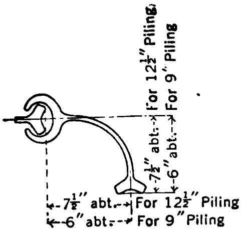
Typical Cofferdam with Partitions



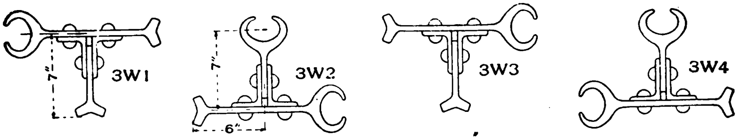
Three Way Junction Pieces - 9" Piling



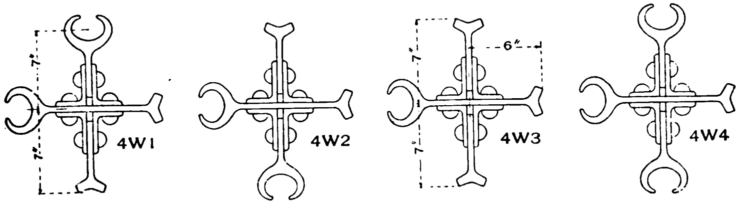
Four Way Junction Pieces - 9" Piling



Corner Piece



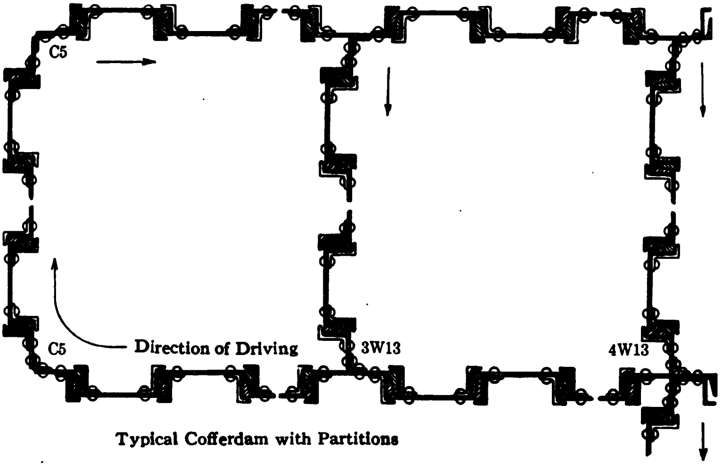
Three Way Junction Pieces-12½" Piling



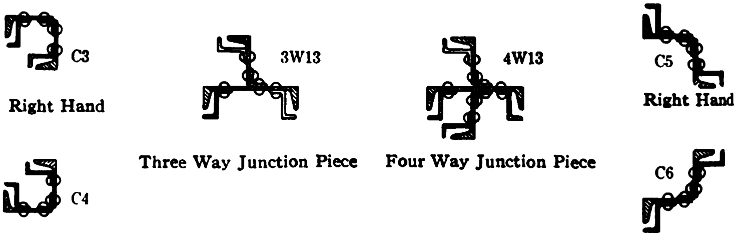
Four Way Junction Pieces - 12½" Piling

Fig. 39—Constructional Details. United States Steel Sheet Piling

STEEL SHEET PILING.—*Continued*



Typical Cofferdam with Partitions



Right Hand

Left Hand
Inside Corner Pieces

Three Way Junction Piece

Four Way Junction Piece

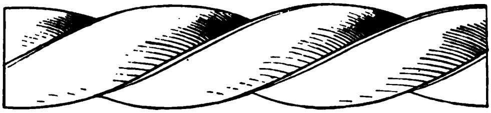
Right Hand

Left Hand
Outside Corner Pieces

FIG. 41—CONSTRUCTIONAL DETAILS, FABRICATED PILING

CONCRETE REINFORCEMENT BARS

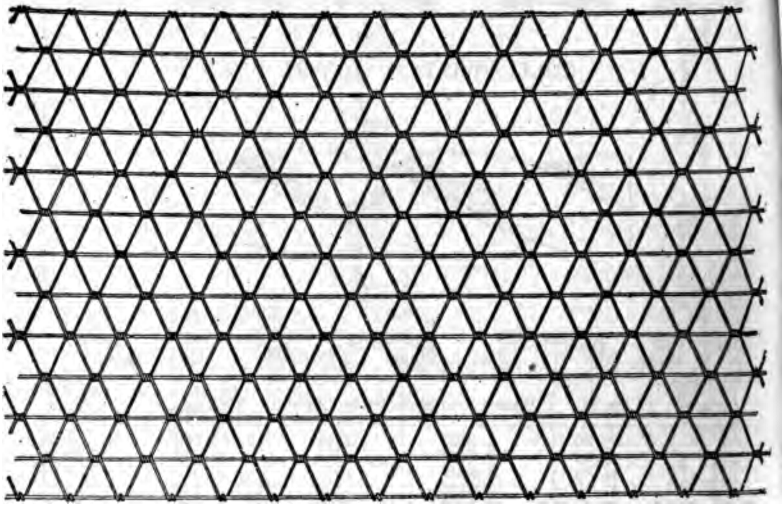
COLD TWISTED SQUARE BARS



Size		Area		Weight	
Inches	m/m	Square Inches	Square m/m	Per Foot, Pounds	Per Meter, Kilos
2	50.80	4.0000	2581	13.600	20.24
1⅞	47.63	3.5156	2268	11.953	17.79
1¾	44.45	3.0625	1976	10.413	15.50
1⅝	41.28	2.6406	1704	8.978	13.36
1½	38.10	2.2500	1452	7.650	11.38
1⅜	34.93	1.8906	1220	6.428	9.57
1¼	31.75	1.5625	1008	5.313	7.91
1⅛	28.58	1.2656	817	4.303	6.40
1	25.40	1.0000	645	3.400	5.06
15/16	23.81	0.8789	567	2.988	4.45
⅞	22.23	0.7656	494	2.603	3.87
13/16	20.64	0.6602	426	2.245	3.34
¾	19.05	0.5625	363	1.913	2.85
11/16	17.46	0.4727	305	1.607	2.39
⅝	15.88	0.3906	252	1.328	1.98
9/16	14.29	0.3164	204	1.076	1.60
½	12.70	0.2500	161	0.850	1.26
7/16	11.11	0.1914	123	0.651	0.97
⅜	9.53	0.1406	91	0.478	0.71
5/16	7.94	0.0977	63	0.332	0.49
¼	6.35	0 0625	40	0.213	0.32

ld twisted bars will conform to Manufacturers' Standard Specifications, unless otherwise specified

TRIANGLE MESH CONCRETE REINFORCEMENT

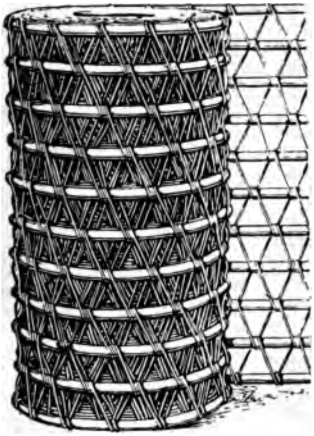


4-inch Triangle Mesh Patents Pending

We desire especially to direct attention to some of the salient features of this style of reinforcement, the demand for which is daily inrceasing and which is being regarded with greater favor than ever by architects and engineers. It is manufactured of hard, cold drawn steel wire with a tensile strength of 85,000 pounds per square inch (59.76 kilos per square millimeter) and an average elastic limit of 50,000 pounds per square inch (35.15 kilos per square millimeter) possessing from 25 to 60 per cent. greater tensile strength than any hot rolled products of a similar area, such as bars, expanded metal, etc., there being no welds in any part of the fabric; the maximum strength of the material is conserved by the process of drawing and the possibility of flaws is entirely eliminated. Furthermore, it is of a truss form of construction, which, in providing one of the best possible mechanical and adhesive bonds in the concrete, reinforces in every direction. Unlike any other form of mesh, the cross wires assist the tension carrying longitudinal members, increasing the effective, sectional area, enabling a lighter material to be used for the same resistance, as well as effecting a more equal distribution of the stresses. Being of hinge joint construction, the fabric is flexible and may be folded on any longitudinal member without bending the cross

TRIANGLE MESH CONCRETE REINFORCEMENT.—*Continued*

wires, consequently can be made to assume various conformations without producing any initial strain. The difficulty of maintaining equal spacing of bars, involving considerable labor, is entirely avoided, as in "Triangle Mesh" the cross wires accomplish this without labor and with perfect exactitude. Supplying it in continuous rolls of 150, 200 and 300 feet (45.720, 60.960 and 91.440 m) long, no material whatever is wasted by longitudinal laps, thus effecting considerable economy, and it can be laid by unskilled labor which is not true of other styles of reinforcement.



4-inch Mesh

The manufacture of 2-inch triangle mesh (except for use with the cement gun or for similar work), and of various other styles shown in our former catalogues and in the "Engineers Handbook of Concrete Reinforcement" published by the American Steel and Wire Company, has been discontinued. New styles have been designed, more appropriate for the various purposes, of graduated sectional areas, and to all of the styles have been given new numbers, which indicate the total effective longitudinal sectional area in square inches per foot width. In the following tables are shown the new numbers of the various styles, with details of the sectional areas, approximate weights in pounds per 100 square feet and in kilos per square meter, lengths of rolls, widths, etc.

Tests, recently conducted in the city of New York, under the supervision of disinterested engineers, clearly demonstrate that this material possesses greater strength in actual practice than we claim for it, fulfilling more than we demand of it, and as additional evidence of its efficiency, official approval has been granted for its adoption in buildings in New York City.

With a view to obtaining the approval of the British authorities, we submitted, for test by the British Fire Prevention Committee, London, a floor of reinforced concrete, reinforced with "Triangle Mesh" reinforcement. The tests, which consisted of a fire test of four hours duration, followed by load and water tests of the same floor, were entirely successful in every respect, and we were awarded the classification of "Full Protection" (Class B).

For further information as to the qualities and uses of "Triangle Mesh" Reinforcement, see "Engineers' Handbook of Concrete Reinforcement," published by the American Steel & Wire Company, which will be furnished on request to engineers, architects, contractors and others interested.

TRIANGLE MESH CONCRETE REINFORCEMENT.—*Continued*

TABLE NO. 1

Longitudinals Spaced 4 Inches (101.6 m/m). Cross Wires No. 14 Gauge, Spaced 4 Inches (101.6 m/m).

NUMBER AND GAUGE OF WIRES, AREAS PER FOOT WIDTH AND WEIGHTS PER 100 SQUARE FEET AND PER SQUARE METER

Style Number	Number and Gauge of Wires, Each Longitudinal, A. S. & W. Gauge	Sectional Area, Longitudinals Square Inches per Foot Width	Total Effective Longitudinal Sectional Area, Square Inches per Foot Width	Approximate Weight	
				Per 100 Square Feet, Pounds	Per Square Meter, Kilos
032	1—No. 12 gauge	.026	.032	22	1.074
040	1— " 11 "	.034	.040	25	1.221
049	1— " 10 "	.043	.049	28	1.367
058	1— " 9 "	.052	.058	32	1.562
068	1— " 8 "	.062	.068	35	1.709
080	1— " 7 "	.074	.080	40	1.953
093	1— " 6 "	.087	.093	45	2.197
107	1— " 5 "	.101	.107	50	2.441
126	1— " 4 "	.120	.126	57	2.783
146	1— " 3 "	.140	.146	65	3.174
153	1— ¼ inch	.147	.153	68	3.320
168	1—No. 2 gauge	.162	.168	74	3.613
180	2— " 6 "	.174	.180	78	3.808
208	2— " 5 "	.202	.208	89	4.345
245	2— " 4 "	.239	.245	103	5.029
267	3— " 6 "	.261	.267	111	5.420
287	3— " 5½ "	.281	.287	119	5.810
309	3— " 5 "	.303	.309	128	6.250
336	3— " 4½ "	.330	.336	138	6.738
365	3— " 4 "	.359	.365	149	7.275
395	3 – " 3½ "	.389	.395	160	7.812

LENGTH OF ROLLS: 150 ft., 200 ft. and 300 ft. (45.72, 60.96 and 91.44 meters).

WIDTHS: 16-in., 20-in., 24-in., 28-in., 32-in., 36-in., 40-in., 44-in., 48-in., 52-in. and 56-in. (0.406, 0.508, 0.610, 0.711, 0.813, 0.914, 1.016, 1.118, 1.219, 1.321 and 1.422 meters).

Ultimate Tensile Strength 70,000 to 85,000 lbs. per sq. in. (49.22 to 59.76 kilos per sq. m/m).

NOTE.—Material may be furnished either plain or galvanized. Unless otherwise specified, shipment will be made of material not galvanized.

Two-inch mesh (2-inch [50.8 m/m] spacing of cross wires formerly known as "A" styles) will be made for USE WITH THE CEMENT GUN or similar work.

TRIANGLE MESH CONCRETE REINFORCEMENT.—*Continued*

TABLE NO. 2

Longitudinals spaced 4 inches (101.6 m/m). Cross Wires No. 14 Gauge, spaced 8 inches (203.2 m/m).

NUMBER AND GAUGE OF WIRES, AREAS PER FOOT WIDTH AND WEIGHTS PER 100 SQUARE FEET AND PER SQUARE METER

Style Number	Number and Gauge of Wires, Each Longitudinal, A. S. & W. Gauge	Effective Sectional Area of Cross Reinforcement, Square Inches per Foot Width	Effective Longitudinal Sectional Area, Square Inches per Foot Width	Approximate Weight	
				Per 100 Square Feet, Pounds	Per Square Meter, Kilos
036P	1—No. 12 gauge	.009	.036	17	0.830
044P	1— " 11 "	.009	.044	20	0.976
053P	1— " 10 "	.009	.053	24	1.172
062P	1— " 9 "	.009	.062	27	1.318
072P	1— " 8 "	.009	.072	31	1.514
084P	1— " 7 "	.009	.084	35	1.709
097P	1— " 6 "	.009	.097	40	1.953

TABLE NO. 3

Longitudinals spaced 4 inches (101.6 m/m). Cross Wires No. 12½ Gauge, spaced 8 inches (203.2 m/m).

NUMBER AND GAUGE OF WIRES, AREAS PER FOOT WIDTH AND WEIGHTS PER 100 SQUARE FEET AND PER SQUARE METER

Style Number	Number and Gauge of Wires, Each Longitudinal, A. S. & W. Gauge	Effective Sectional Area of Cross Reinforcement, Square Inches per Foot Width	Effective Longitudinal Sectional Area, Square Inches per Foot Width	Approximate Weight	
				Per 100 Square Feet, Pounds	Per Square Meter, Kilos
041R	1—No. 12 gauge	.014	.041	21	1.025
049R	1— " 11 "	.014	.049	24	1.172
058R	1— " 10 "	.014	.058	28	1.367
067R	1— " 9 "	.014	.067	31	1.514
077R	1— " 8 "	.014	.077	35	1.709
089R	1— " 7 "	.014	.089	40	1.953
102R	1— " 6 "	.014	.102	44	2.148

LENGTH OF ROLLS: 150-ft., 200-ft. and 300-ft. (45.72, 60.96, and 91.44 meters).

WIDTHS: 16-in., 20-in., 24-in., 28-in., 32-in., 36-in., 40-in., 44-in., 48-in., 52-in. and 56-in. (0.406, 0.508, 0.610, 0.711, 0.813, 0.914, 1.016, 1.118, 1.219, 1.321 and 1.422 meters).

Ultimate Tensile Strength 70,000 to 85,000 lbs. per sq. in. (49.22 to 59.76 kilos per sq. m/m).

NOTE.—Material may be furnished either plain or galvanized. Unless otherwise specified, shipments will be made of material not galvanized.

CONCRETE PAVEMENTS AND ROADWAYS REINFORCED WITH TRIANGLE MESH

Plain concrete pavements and roadways have been built quite generally in the United States and Canada since 1903. Various defects have been discovered which have militated against their advisability. A great many of the difficulties encountered in plain concrete pavements were eliminated when Triangle Mesh Concrete Reinforcement was put on the market. By the use of the proper style of wire mesh reinforcement a permanent and highly satisfactory pavement is now obtainable at a small additional cost, varying from five to twenty cents per square yard.

The chief reason for the use of wire mesh reinforcement in the construction of concrete pavements and roadways, is the possible unsatisfactory foundation of sub-soil, and contraction and expansion stresses. The formation of cracks, due to the soft and yielding sub-soil, can be prevented only by the use of the proper amount of steel reinforcement. In this case the reinforcement is used to add structural strength to the concrete slabs. It is advisable to improve the conditions of the foundation by drainage, by the removal of at least a portion of the sub-soil, replacing it by crushed material, and by rolling. Owing to peculiar local conditions these methods may be impracticable.

If steel reinforcement is placed in the pavement for the purpose of adding to its structural strength, that is, to increase the efficiency of a weak sub-soil, it is placed as near to the bottom of the concrete slab as possible, and yet high enough to secure the necessary protection for the steel. The amount of reinforcement required for this purpose depends entirely upon the conditions. In some cases a light reinforcement which is obtained through the use of Triangle Mesh Reinforcement, Style No. 049, would be sufficient; in other cases a much heavier style may be necessary. The amount of reinforcement for this purpose should be determined in each case by the engineer in charge of the design.

The amount of reinforcement required to prevent the splitting off of the wearing-coat on a two-course pavement, and to eliminate the cracks due to expansion and contraction stresses can be easily determined without a definite study of the specific conditions. By referring to the examples of reinforced concrete pavements as shown on pages 38 to 63 of our catalogue, "Triangle Mesh Wire Reinforced Concrete Pavements and Roadways," it will be seen that the reinforcement used for this purpose varied from Triangle Mesh, Style No. 032, having a cross sectional area of .032 square inch per foot width up to and including Style No. 093, having a cross sectional area of .093 square inch per foot width.

CONCRETE PAVEMENTS AND ROADWAYS REINFORCED WITH TRIANGLE MESH.—*Continued*

Although apparently the light mesh has given good satisfaction, it is our opinion that for the slight additional expense involved it is decidedly advisable to use a heavier material. For narrow streets and roadways, up to twenty feet (6.096 meters) and where the transverse expansion joints are spaced not to exceed thirty feet (9.144 meters), we advise the use of Style No. 049, which gives approximately the same sectional area of steel in both directions. For wider streets, or where the transverse joints are spaced not to exceed fifty feet (15.24 meters), we would suggest the use of Style No. 058. The usual practice has been to place the longitudinal wires crosswise the street with the reinforcement placed between the base and wearing courses of two-course pavements, and two inches (50.8 m/m) below the surface of one-course pavements.

Comparative Value of Different Pavements

From Circular No. 141—Forest Service—U. S. Department of Agriculture

PAVEMENT QUALITIES	Per Cent. For Ideal Pavement	Granite	Sandstone	Asphalt (Sheet)	Asphalt (Block)	Brick	Macadam	Creosoted Wood Block	Concrete
Cheapness—First cost	14	4	4	6.5	6.5	7	14	4.5	13
Durability	20	20	17.5	10	14	12.5	6	14	17
Ease of Maintenance	10	9.5	10	7.5	8	8.5	4.5	9.5	9
Ease of Cleaning	14	10	11	14	14	12.5	6	14	14
Low Tractive Resistance	14	8.5	9.5	14	13.5	12.5	8	14	14
Non-slipperiness	7	5.5	7	3.5	4.5	5.5	6.5	4	6
Favorableness to Travel	4	2.5	3.5	4	3.5	3	3	3.5	4
Acceptability	4	2	2.5	3.5	3.5	2.5	2.5	4	4
Sanitary Quality	13	9	8.5	13	12	10.5	4.5	12.5	13
Total	100	71	73.5	76	79.5	74.5	55	80	94
Average Cost per Square Yard (1905)		$3.26	$3.50	$2.36	$2.29	$2.06	$0.99	$3.10	$1.25
Average Cost per Square Meter (1905)		$3.90	$4.19	$2.82	$2.74	$2.46	$1.18	$3.71	$1.50

NOTE.—The values for concrete pavements given in the last column are here added for comparison and were not included in the Government report.

For reinforcing concrete pavements and roadways, a woven wire reinforcement is the best that can be used, due to its economy in laying and superiority over other methods of reinforcement.

Reinforced concrete pavement and roadways have all the desirable features. They are low in original and maintenance cost. They have great durability and give low tractive resistance with good foothold. They offer many traffic advantages, are sanitary, easy to clean, and free from dust.

Our catalogue entitled "Triangle Mesh Wire Reinforced Concrete Pavements and Roadways," which gives full information regarding concrete pavements, will be forwarded on request.

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